SCIENTIFIC AMERICAN

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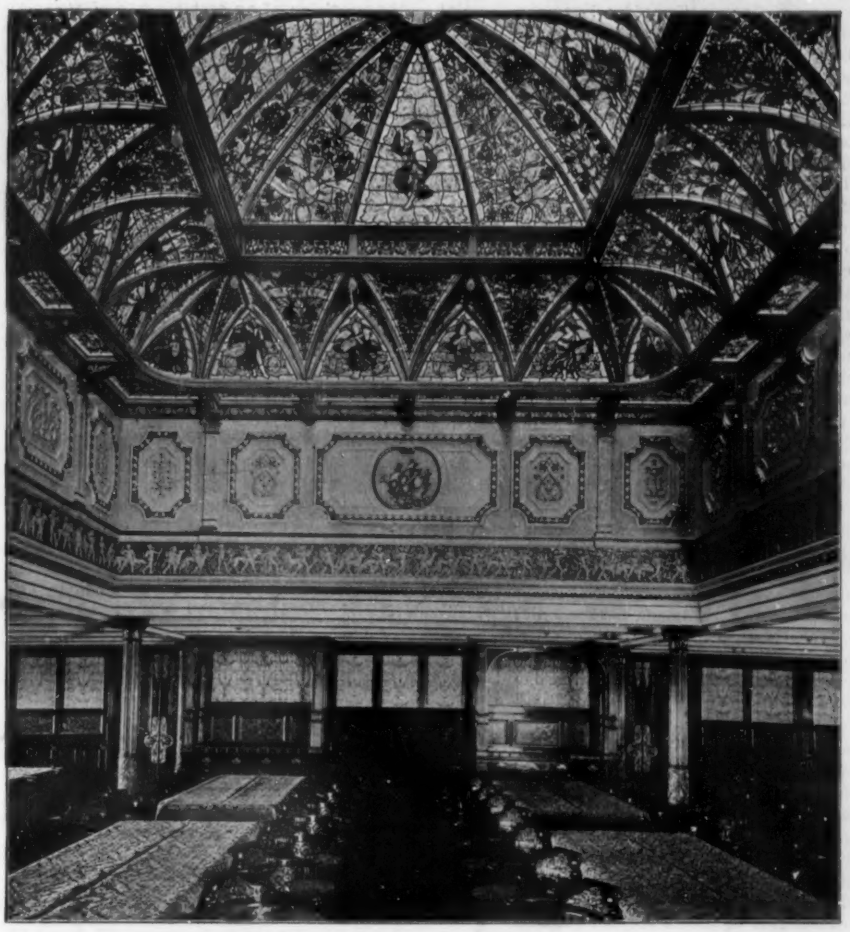
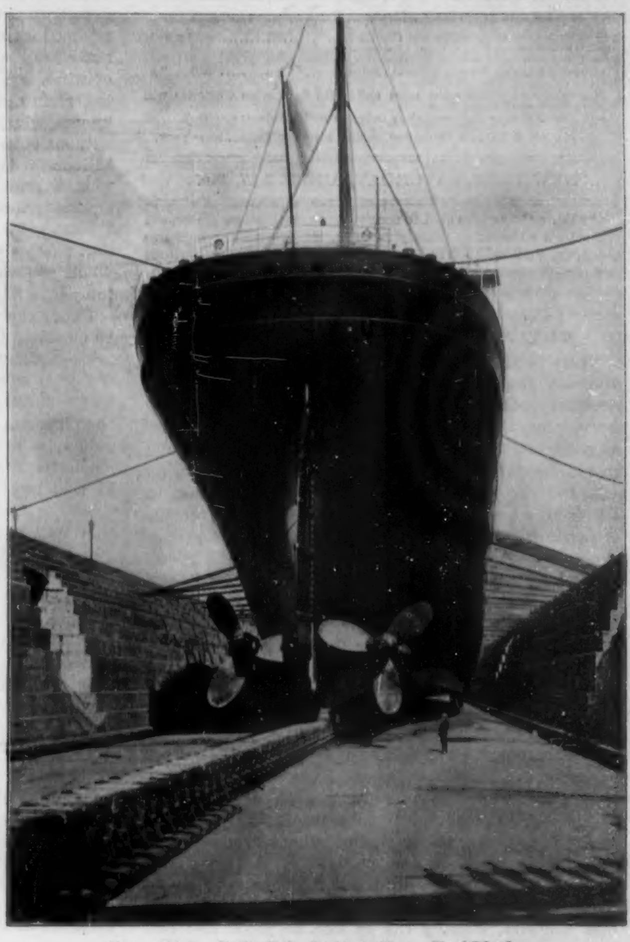


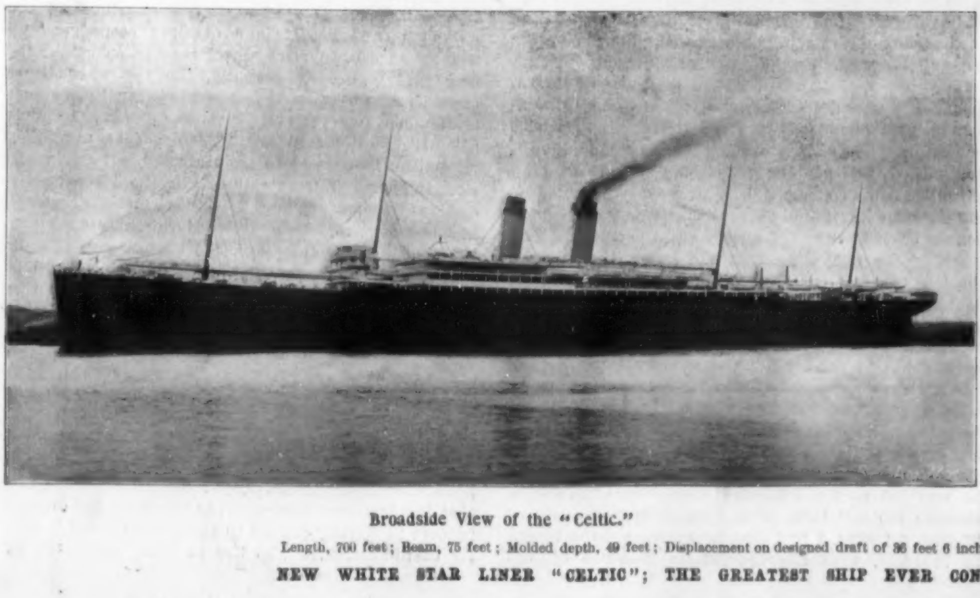
View Beneath Dome of Dining Saloon.



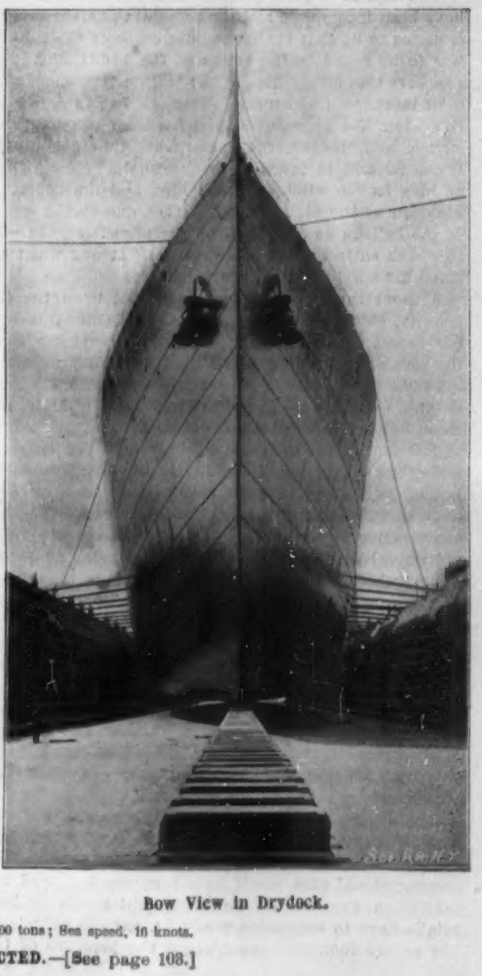
Stern View—Taffrail is 65 Feet Above Keel-Blocks.

Saloon Smoking Room.

A First-Class Stateroom.



Broadside View of the "Celtic."



Bow View in Drydock.

Length, 700 feet; Beam, 75 feet; Molded depth, 49 feet; Displacement on designed draft of 36 feet 6 inches, 37,700 tons; Sea speed, 16 knots.

NEW WHITE STAR LINER "CELTIC"; THE GREATEST SHIP EVER CONSTRUCTED.—[See page 103.]

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NEW YORK, SATURDAY, AUGUST 17, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

MISHAP TO THE SANTOS-DUMONT AIRSHIP.

There will be general sympathy with M. Santos-Dumont, the persistent and plucky aeronaut, in the disaster which overtook him just at the very time when he seemed to have the Deutsch prize within his grasp. He started from St. Cloud and sailed directly for the Eiffel Tower, covering the distance of 9 kilometers, or over 5 miles, in the remarkable time of 9 minutes and 20 seconds. Reports of the trip are somewhat contradictory; but it would seem that, shortly before reaching the tower, the balloon commenced to deflate and the pointed bow began to give way under the end-on resistance of the air. The airship was deflected from its course, but by the skill of M. Santos-Dumont it was brought back and made the circuit of the tower successfully. The further deflation of the balloon seems to have caused some of the suspension ropes to slacken up and become entangled and broken by the propeller. Luckily for the aeronaut, the machine descended upon the roof of one of the taller buildings of Paris and hung there, M. Santos-Dumont being rescued without any injury to himself. The accident is ascribed by the inventor to the imperfect inflation of the balloon, coupled with the varying direction and strength of the wind. He states that he was already returning over the Bois de Boulogne when the wind freshened suddenly and struck him sidewise, causing the balloon to pitch and roll heavily.

Although it is quite possible that the inflation may have been incomplete and the regulating valves faulty, it seems to us that the immediate cause of the failure was to be found in the action of the wind; and it is just here that all airships of the balloon type encounter their most frequent cause of disaster. In running with the wind the aeronaut experienced no practical reverses, and, indeed, the remarkable time made—between 30 and 40 miles an hour—would indicate that as long as the wind was with him, and the opposing pressure of the air was simply that due to the speed of the balloon as developed by the propellers, the airship was entirely within his control. It was when he faced the wind that his troubles began.

Without throwing the least discredit upon the ingenuity, skill and perseverance of M. Santos-Dumont, the recent accident really confirms our opinion that the successful airship, aeroplane, or flying machine must, in the nature of things, dispense with the gas-inflated balloon. By the term "successful airship" we mean one which can take its place in the great world of transportation, and hold its own with the railroad train, steamship, or automobile, for the conveyance, if not of freight, at least of passengers. Such an airship must, like the modern first-class steamship, be comparatively independent of the elements. It must not only be able to show a speed of from 60 to 80 miles an hour, with the wind, but it must be capable of maintaining a speed, say, of not less than 30 or 40 miles an hour against the wind, even when the strength of the latter is from 30 to 50 miles an hour. This, we believe, is something that the gas-supported airship will never accomplish, and for the reason that to overcome the end-on resistance and skin friction presented by the large cross-section and surface area of the balloon to the air, the propelling machinery would have to be of a power and weight greatly exceeding the lifting capacity of the balloon. Let us take, for example, the machine that was recently wrecked in Paris. It is supported by a cigar-shaped balloon, which has a length of 110 feet, and a diameter of 20 feet. The cross-sectional area would be 315 square feet, and the maximum pressure of the wind which the balloon might have to encounter would be, say, 40 pounds to the square foot, this being about the pressure of the wind allowed for in calculating the wind stress on bridges and framed structures. The fact that the balloon is cigar-ended is offset by the large skin friction; but to be conservative we will suppose that the maximum pressure parallel with the longer axis would be only three-fourths of this, or 30 pounds to the square foot. This would amount to an end-on pressure of 4¾ tons on the balloon alone. It is not necessary to follow the calculation any further, as it is evident that in the present state of the mechanical arts there is no form of motor which could develop the necessary power within the limits of weight that can be carried by a balloon of this size.

To look at the question from another side: Even supposing that machinery could be designed which would not merely hold the balloon stationary against a gale of wind, but drive the ship forward at a fair speed, it is certain that there is no form of balloon construction known which could encounter such wind pressures without collapsing. It might be answered: "Make the balloon stronger," but to do this would be to increase weight, and a larger gas-holding capacity would be necessary to support the increased load. As far as we know, no gas-supported machine has yet been built that was able to make good progress against a strong wind, and the considerations quoted above show the inherent difficulties of the task.

Under the present conditions of aeronautics it must be admitted that, although the effort of inventors is at present almost entirely directed to the balloon airship, the true solution of the problem would seem to lie where nature suggests that it does lie; namely, in the direction of the aeroplane, a type of airship whose principles are identically the same as those which underlie the flights of birds. What are experimentalists in this most scientific and promising field doing in these days? We hear but little of them. It is possible that they have been discouraged by the extreme risks which attend all aeroplane experiments that are carried out on a large scale. The death of Lilienthal and other martyrs to a fascinating and dangerous science has not, however, proved that aeroplane navigation is impossible; quite the contrary. What it has proved is that the aeroplane only awaits the invention of some automatic means of balancing to render it one of the most successful inventions of the twentieth century.

BIG SHIPS AND DEEP WATERWAYS.

The arrival of the great steamship "Celtic" in the port of New York shows the wisdom of the liberal appropriations recently made by the United States government for providing the harbor of New York with a 40-foot channel from the docks to deep water outside the bar. It is evident, in considering the question of the dimensions of future steamships, that they will be limited only by the harbor and dockage facilities afforded them. The city of New York recently constructed a set of piers with the unprecedented length of 800 feet, and yet they had scarcely been completed before the "Oceanic," with a length of 705 feet, was tied up alongside of them. And now we have but just commenced to dredge out our 40-foot channels, when a vessel enters our harbor with a maximum designed draft which will leave only a few feet margin between its keel and the bottom of the channels when they are finished.

At the time of the launch of the "Celtic" the question of the economics of big ships was very ably discussed by our contemporary, The Shipping World, of London, and facts were given, showing that with every increase in the dimensions of the large freighters there was a corresponding decrease in the cost of transporting freight. The most costly item in the running of these ships is fuel, which, for a vessel of 8,000 or 9,000 tons displacement, is reckoned at about $2.10 per mile steamed; the wages, provisions, upkeep, repairs, interest on capital, etc., costing about 60 cents per mile steamed. As the result of returns covering a large number of voyages, it has been shown that a 4,000-ton steamer, steaming 269 miles per day, consumed 0.081 pounds of coal per ton of displacement per mile; a 5,000-ton steamer traveling 260 miles a day burned 0.067 pounds; a 7,000-ton steamer running 264 miles a day consumed 0.048 pounds; while a 9,000-ton steamer steaming 267 miles burned only 0.036 pounds of coal per ton of displacement per mile. From these figures it is seen that the larger the steamer the less the coal consumption *pro rata*—in fact, that doubling the size of the steamer halves the coal consumption per ton. The significance of these facts is evident when we remember that the coal expense represents about 60 per cent of the total running expense of a ship.

In a paper read before the Institution of Naval Architects, on "Large Cargo Steamers," Prof. Biles has stated that as the result of his investigation of the effect of increase of size upon working expense he was led to the following conclusion: "Taking a steamer 500 feet long, 60 feet broad, with a depth of 27 feet, 6 inches, I find that by increasing the length to 700 feet, with a proportionate increase of the breadth, but keeping the draught stationary at 27 feet 6 inches, the cost of carrying a ton of cargo 5,000 knots at 12-knot speed, increases from $2 to $2.75. But if the draught, instead of being kept constant, is increased in proportion to the increase in the other dimensions, the cost of carrying a ton of cargo the same distance at the same speed, decreases from $2 in the case of a 500-foot ship, to $1.75 in the case of the 700-foot ship." Thus, it is shown that if the draught be increased proportionately to the increase of the other dimensions, the cargo can be carried at a steadily decreasing cost as the size increases. The obvious moral of this is that considerations of economy point to the provision of an ample depth of water in and approaching the great shipping ports of the world.

A further explanation of the great economy realized by big ships is found in the fact that a given amount of cargo will be transported in a smaller number of voyages, thereby greatly decreasing docking and other charges. A comparison of the first "Oceanic" of the White Star Company in 1871 with the "Celtic" of 1901, shows that the first boat was 420 feet long, 41 feet beam, and 31 feet deep, with a tonnage of 3,707. Her average speed was 14 knots, and she consumed about 65 tons of coal a day. The "Celtic" has a tonnage of 20,800 on her draught of 39 feet 6 inches, and at her maximum power she will steam 17 knots on a consumption of 260 tons of coal a day. Her speed is about 25 per cent better than that of the earlier boat, and it is estimated that she could carry about four of the first "Oceanic's" cargoes at the cost of one such cargo when carried in the older ship.

The question arises, if the economic inducements for the construction of mammoth vessels are so great, what is the limit to the possibilities of size? The answer is that the limit is determined purely by the harbor accommodations, and that if terminal facilities in the way of 50 to 60 foot channels and 1,500-foot docks were provided we should probably see vessels of double the size of the "Celtic" plying across the Atlantic. If any reservation is to be made in the above statement, it must be on the score of loading and unloading facilities; for the managers of the great steamship lines are already complaining of the extreme difficulty of getting the vast cargoes aboard of these ships in the limited time available between arrivals and departures.

HUMIDITY AND HEATING SYSTEMS.

Under the title of "School Room Temperature and Humidity," a valuable paper was recently read before the Department of School Administration, Detroit, by Mr. William George Bruce, which we strongly recommend to the attention of the directors of our public schools. The paper is too lengthy for the columns of the SCIENTIFIC AMERICAN, and will be found in full in the current issue of the SUPPLEMENT. It draws attention to the fact that there is in the management of school houses a tendency to confound the question of temperature-regulation with that of ventilation. While most school officials, if asked pointblank to define the difference between the two, would probably give a correct answer, it is a fact that they are thoughtlessly confused in practice. It is one thing to provide a class room constantly with fresh air; it is an entirely different thing to so regulate that air that it shall be neither too warm nor too cool. Temperature-regulation in school rooms should be a simple proposition. If the outside temperature is 50 deg. and the school temperature should be 70 deg., only 20 deg. of artificial heat is required to render the school room comfortable. Therefore, the fuel expenditure should be sufficient to cover 20 deg. only, and if it comes above this, it is merely waste and extravagance. An open window to cool off an overheated room is an unwarranted exposure of the children; and yet it is a constant occurrence, we venture to say, in most school rooms throughout the country. While, theoretically, the fuel expenditure should cover only the difference between the outdoor and indoor temperature, it is certain that the most attentive janitor will be incapable of so accurately regulating his fire as to maintain without any variation the desired temperature. In the forenoon the outdoor temperature may be 40 deg., and in the afternoon 50 deg., and though the janitor may anticipate the change in temperature, the chances are that he will not. The solution of the above problem will be found in some well-adjusted mechanical device that will regulate the temperature from hour to hour without any manual assistance.

Perhaps the most valuable hints conveyed in this paper occur where the author treats of the subject of atmospheric humidity, or air moisture, in relation to indoor heating. This is an element in the problem of artificial heating which has never received the measure of attention which its importance demands. It is a well-established, though too little known, fact that the degree of heat which is necessary for comfort indoors is directly related to the percentage of humidity of the air. We who live in New York know by

bitter experience that a summer temperature which is comfortable when the percentage of humidity is low, becomes insufferable when that percentage is high. This is explained by the fact that when the air is dry, evaporation from the body is rapid, and the latent heat of evaporation, being drawn from the body, cools it off proportionately. When the atmospheric humidity is high, the air is less able to receive fresh moisture, evaporation from the body is slow, and its temperature is correspondingly high. Applying this to the low temperature of the winter season, we find that the very dry air of many houses conduces to a rapid evaporation from the human body, and a corresponding lowering of its temperature. Hence the interior of a house in which the air is abnormally dry must be at a higher temperature to be comfortable than an interior in which the percentage of humidity is high.

Speaking upon this question, Dr. W. M. Wilson, of the United States Weather Bureau, who has given the subject careful study, says: "It is safe to assume that during the winter months the normal relative humidity in lake cities is 72 per cent. From observations with respect to moisture in business offices and living rooms heated by steam, hot water and hot air, it is safe to assume that the average relative humidity in artificially heated dwellings and offices in the winter months is about 30 per cent, or about 42 per cent less than the average outside humidity, and drier than the driest climate known."

As the evaporative power of the air at a relative humidity of 30 deg. is very great, the tissues and delicate membranes of the respiratory tract are subjected to a drying process and a great increase of work is placed upon the mucous glands in the effort to compensate for the lack of moisture in the air. This increase of activity, and the frequent unnatural stimulation induced by the changing conditions of humidity from the moisture-laden air outside to the dry temperature inside of our dwellings, result in an enlargement of the gland tissues and a thickening of the membrane itself. It is only a question of time when the surface is prepared for the reception of germs of disease which tend to develop under exposure to the constantly changing conditions referred to. It has been stated by engineers who have given careful study to the subject that by holding the temperature of our school rooms, living rooms and offices at 60 deg. and raising the humidity to 70 per cent, about 25 per cent of the cost of heating might be saved. It is suggested by Dr. Wilson that to avoid the possibility of unpleasant results from condensation, our dwellings could be heated to 65 deg. with a relative humidity of 50 per cent and a saving of from 12½ to 15 per cent secured over the present cost of heating.

This interesting paper naturally raises the question as to whether humidity can be brought under proper mechanical control. That is to say, can atmospheric moisture be supplied artificially and accurately to the extent that may be desired? This is a field of research and experimentation in which some good results have been achieved, but which is yet open for considerable improvement. If the public could be brought to understand how intimately the question of humidity is associated with that of temperature in the matter of heating, there would be a demand for artificial control of humidity, which would react with a beneficial effect on the whole of the steam-heating industry.

THE PROPOSED HISTORY OF THE PATENT OFFICE.

The Patent Office of the United States has now been in existence one hundred and eleven years. During that time it has ever been one of the most efficiently conducted branches of the governmental service. Perhaps because it has so admirably met the requirements of the public, and perhaps because it has been protected as far as possible from baneful political influence, the Patent Office is rarely mentioned in the daily press and is, consequently, the one department of our government about which least is known. For the purpose of enlightening the general public on the work which the office has conscientiously performed during its existence, and of placing in the hands of inventors a book which will explain the method of procedure in obtaining patents and which will give such general information as may be valuable, the Commissioner of Patents has authorized the publication of "a complete history of the Patent Office, with useful miscellany." In the Official Gazette a letter has been published inviting all persons to furnish the chief clerk of the office with rare documents, printed articles, or material not readily obtainable that may p.ove of value in compiling the work.

The literary labor of preparing this history for publication has been entrusted by the Commissioner to five principal examiners, the chief of the Issue and Gazette division, and the chief clerk. This publication commission has already outlined the general plan of the history. From information which we have received the work will be a reference book of vast scope.

The historical chapters will begin with a discussion of mediæval royal monopolies and will show how they differ from the present patents. Besides narrating the history of patents in the United States, the work will describe the organization and administration of the Office, discuss the aims and advantages of the present system, compare that system with the methods followed in foreign countries, and briefly analyze our present laws. The commercial benefits to be derived from a well-conducted patent system will likewise form the subject of a chapter which should prove of unusual interest. One of the most important parts of the history will comprise a careful financial study of the value of patented inventions to the country at large. Statistics will be given to show how enormously the national wealth has been increased by the invention of such devices as the trolley, the telephone, the telegraph, the bicycle, Bessemer steel, the cotton gin, the steam engine, fireproof buildings, and labor-saving machinery. Abstracts from the reports of the Bureau of Labor will demonstrate what the patent system has done to cheapen the price of commodities by fostering inventions. Among the miscellaneous matter which will be included may be mentioned the articles on negro, Indian and women inventors; on the inventive genius of various races; and on the relation of environment to invention, as well as studies of certain prolific inventors, and a brief history of some principal arts.

That so ambitious a work, if successfully completed, will prove of inestimable value cannot be doubted. The office has received innumerable calls from legislators for specific reports on various topics, communications from all parts of the world requesting information not readily obtainable, and, indeed, has itself felt the need of a text-book which could be used by the examiners and their assistants. Hitherto it has been almost impossible to obtain accurate information upon certain subjects pertaining to the work of the Patent Office. Official reports, most meager in their details; the "fire issue" of the Official Gazette which bears the date of October 9, 1877; a handful of congressional documents bearing only upon certain points; Campbell's "The Patent System of the United States;" various periodicals, containing scattered articles comprise the entire information on the patent system at present readily available to the public. To issue a work which would exhaustively treat of the origin, development, and present condition of our Patent Office would be a task which no single person could successfully hope to perform. Only by setting all the machinery of the government in motion and by gathering from official as well as private sources the facts which have accumulated in a hundred years is it possible to bring forth a work in which the United States Patent Office of the past and of the present will be adequately described. From the present indications it seems reasonably certain that the history will be ready for distribution at the opening of the St. Louis Exposition of 1903.

WATER-TUBE VS. FIRE-TUBE BOILERS FOR NAVAL USE.

As our engineering readers are aware, recent experiments were instituted by the English government to determine the relative advantages of two types of boilers, fire-tube and water-tube, the test being made with two naval ships of nearly equal powers and displacements in a race of 1,000 miles, more or less, the vessel arriving first being considered the victor. It seems scarcely possible that such a trial as this has the countenance and support of English engineers generally, for it is in no sense conclusive or satisfactory as to the relative values of either type for naval work, being a sort of go-as-you-please contest, depending largely upon extraneous conditions as to the result, wholly unconnected with the boilers or their management. In this particular "race," as it was called, the fire-tube boiler arrived first, but the weather was so bad, by reason of fog, that the vessel it was in might just as easily have been the last.

Speed in a war vessel is, of course, of the first importance to catch enemies who are trying to escape, but there are other qualities equally necessary, and one of these is that the boilers of such vessels shall be able to keep the sea for a long time without needing repairs that cannot be made on board, also that the boilers shall be capable of being brought into full power quickly, and be easily managed during action. No one type combines all these qualifications, and it is not surprising that naval boards are puzzled as to a choice; there is much to be said for both fire-tube and water-tube boilers, but one of the greatest objections to the fire-tube type, as exemplified in the Scotch boiler, so called, is its extreme weight. The shell-plates of these boilers are from one inch and one-quarter to nearly one and one-half inches thick, or about 56 pounds per square foot; as the boilers are about fifteen feet long by the same diameter, it is easy to see that the shells alone are exceedingly heavy. In addition to this the tubes, furnaces and fixtures generally add a great deal more weight. The Scotch boiler is objectionable from the great difference of temperature between the top and bottom of the shell, and is subjected to enormous strains from this cause alone, aside from that of the steam pressure. The combustion chamber at the end, and the circular furnaces as well, give a great deal of trouble, and the fire-tube boiler requires a lot of watching—with modern steam pressures—to keep it up to its work. But the water-tube has troubles of its own also. Although it is lighter for a given power, and a quick steamer and 200 pounds per square inch can be generated from cold water in thirty minutes without injury, while it takes less space than a fire-tube boiler of the same evaporative power, the tubes, both small and large types, are a constant source of anxiety. With anything like fair treatment, however, the water-tube marine boiler does good work, and is capable of long-continued action.

The United States gunboat "Marietta," having water-tube boilers, went around the world, made quick time, and needed no repairs except renewal of a few tubes in her boilers, but naval officers are by no means a unit for their adoption, each type having its partisans. In our own navy we have vessels fitted with both kinds, fire-tube and water-tube boilers, in one ship, for the purpose of instituting comparison side by side, but neither type has been declared wholly unobjectionable, and the probabilities are that the battle of the boilers will be something like that between guns and armor—as much may be said upon one side as the other.

SCIENCE NOTES.

In 1900 in the Punjab, a section of India, where about one-half a million persons die annually, only 893 were killed by snake bites. Their bite is more often inflicted in houses than either in the fields or in the jungle. During the year in question 1,374 wild animals were slaughtered, including 11 tigers, 186 bears, 184 leopards and 99 wolves; 13,272 snakes were killed.

An expedition to Kolynsk, Russia, is being made by Russian scientists in order to bring to St. Petersburg the mammoth which has recently been discovered. It is unique of its kind, its hair, skin and flesh being entirely preserved, and there are remains of undigested food in its stomach.

The Small Art Palace, one of the permanent buildings of the Paris Exposition of 1900, will be used as an Art Museum for the city, and will receive the collections of works of art which are at present scattered in various places, says The Builder. A special architectural gallery will be provided in which drawings and models can be preserved.

An effort is to be made to remove a large red oak tree from the wildest section of Arkansas to Forest Park, St. Louis, for the Louisiana Purchase Exposition. The tree is 160 feet high and 12 feet in diameter at the base. A double tramway will be built from the tree to the river, where it will be floated and towed to St. Louis. It is estimated that this will occupy six months. The tree will be dug up by the roots instead of being cut, and none of its branches will be trimmed, so that it will appear on exhibition just as it now stands in the woods.

Consul-General Hughes writes from Coburg that, according to the German press, fibroleum, a new artificial leather, has just been invented by a Frenchman. It consists of pieces of refuse skins and hides, cut exceedingly small, which are put into a vat filled with an intensely alkaline solution. After the mass has become pulpy, it is taken out of the vat, placed in a specially constructed machine, and after undergoing treatment therein, is again taken out and put through a paper-making machine. The resulting paper-like substance is cut into large sheets, which are laid one upon another, in piles of from 100 to 1,000, and put into a hydraulic press to remove all moisture. The article is strong and pliable, and can be pressed or molded into all kinds of shapes and patterns. It is said to make the best kind of wall paper. Decorators who have used this article speak of it in the highest terms.

Dr. Alvah H. Doty, Health Officer of the Port of New York, has tried some experiments on the extermination of mosquitoes. His operations were confined to the basin in which is the malaria-infected village of Concord, S. I. Four ponds and a marsh were treated with crude oil donated by an oil company. A 100-barrel tank was run on a railroad siding and the oil was allowed to flow into a portable tank of 10 barrels' capacity. The tank was then taken to the scene of operations. Attached to the small tank was a compressed-air cylinder, and a pressure of 20 pounds to the square inch was used. From the valve of the tank ran a 200-foot hose which connected with a float which carried perforated gas pipes, so that the oil could be forced below the surface of the pond. When the pressure was applied the oil and water were thoroughly mixed. The float was drawn back and forth, so that every foot of the water was covered. The oil as it rose to the surface collected at the edges of the pond, thus destroying any matured larvæ. The experiment is watched with the greatest interest.

Electrical Effects—Luminous and Vibratory.

M. D. Negreans, of Paris, has made an interesting series of experiments relating to the vibrations and luminous effects produced in metallic wires by a Wimshurst machine. If one pole of the machine is connected to a wire stretched, insulated and contained in a tube, the other pole of the machine being connected to earth, the wire is seen to make transverse vibrations. If the vibrating wire is observed in the dark, alternately luminous and obscure portions are seen. When the wire is attached to the positive pole of the machine the phenomenon takes the form of brilliant and equidistant lines, which are wider at the middle of the wire and thinner at the ends. In the case of the negative pole, a series of equidistant luminous points is seen all along the wire. The experiment was made with a glass tube 8 feet long and 2.4 inches diameter, and a wire gaging 0.1 inch. If two wires of the same length are stretched parallel and connected with the two poles of the machine (the outer ends being electrically free), the wires enter into vibration. In the dark, a series of equidistant luminous points are seen on the negative wire, while on the positive is a series of luminous lines whose centers correspond to the luminous points of the first wire. The experiment is very brilliant if the two wires are fused in the ends of a glass tube, and the luminous lines and points appear very regular. If the wires are close enough together, only one of them need be attached to the machine, the second being connected to earth, thus giving a condenser effect.

IN THE TERMINAL STATION AT BUFFALO.

BY ARTHUR B. WEEKS.

As has been heretofore stated in a recent article in these columns, a third transmission line, of aluminium, has been finished and is now in operation between the cities of Niagara Falls and Buffalo, carrying electric current from the Niagara Falls Power Company's plant to the Pan-American Exposition. In the terminal station, just within the city limits of Buffalo, is found a fine example of modern insulating construction and protective devices, the experiences of years having brought to bear in producing marked changes and wonderful developments in the handling of high voltages.

The cables, on entering the terminal station, are connected to the time limit relay circuit-breakers and switches shown in one of the accompanying illustrations. At the rear of these specially built panels are the lightning arresters, consisting of spark gaps and choke coils. From these panels the cables are continued to six Westinghouse static interrupters, 100 amperes at 22,000 volts, one on each pole, a common ground wire being used for the interrupters, between each of which and the ground an inclosed fuse is in circuit.

From these interrupters, located in the rear of the transformers shown in our second engraving, the two three-phase circuits are continued and next connected to the six 2,250-kilowatt Westinghouse transformers, which, like others of that make, are oil-insulated and water-cooled.

The pressure is here reduced to 11,000 volts, and the three-phase cables continued to the distributing board, as will be seen in our third engraving. Here they are connected to two sets of bus-bars run through vitrified tiles, to prevent short circuits. From the bus-bars a number of circuits run.

The cables coming from the transformers extend upward through the floor, through porcelain insulators, at the rear of the distributing board. The circuits have single element switches which may be connected to either set of bus-bars. Each circuit on the distributing board has its circuit-breaker and switch. Some lesser parts of the wiring are as yet incomplete, as well as a railing which will take the place of ropes now stretched before the open, unprotected switches. In our illustration is shown a platform where circuit-breakers are opened or closed by means of a hand lever.

RELATIVE SPEED INDICATOR.

Kilroy's relative speed indicator, which is manufactured by Messrs. Evershed & Vignoles, Limited, Woodfield Works, Harrow Road, London, has been devised in order that those in charge of the engines

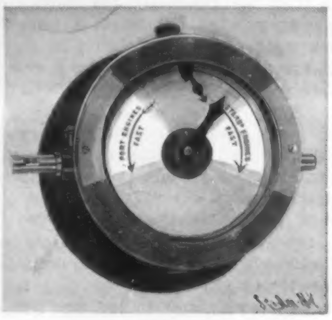


Fig. 1.

in twin-screw ships may be able to know at a glance whether the port and starboard engines are running at equal speeds, and, if not, which is going the faster. The indications given by this indicator are such as to enable the engineers quickly and easily to bring the engines to equal speeds, and maintain them so. The advantages gained in the engine-room by the use of this indicator are self-evident to those used to the management of marine engines. Deck officers will appreciate the benefits derived, as the equal running of the two engines, besides insuring a slightly better

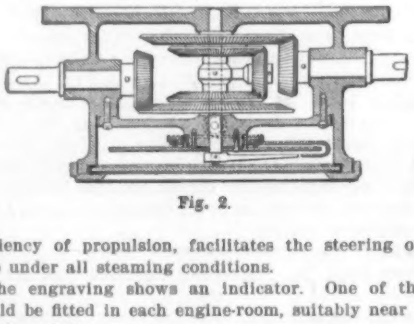


Fig. 2.

efficiency of propulsion, facilitates the steering of a ship under all steaming conditions.

The engraving shows an indicator. One of these would be fitted in each engine-room, suitably near the starting platforms.

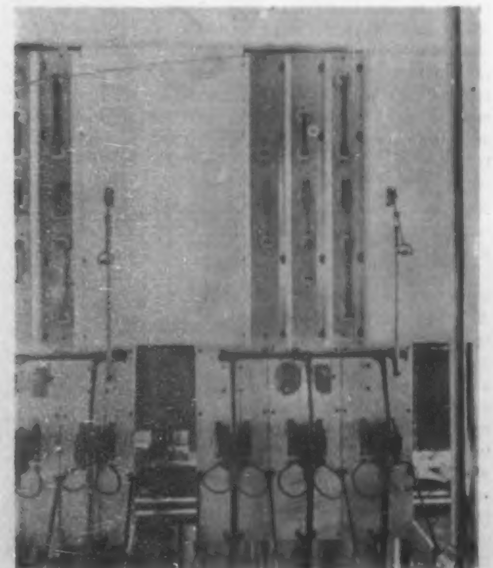
When the two engine-rooms are separated by a water-tight bulkhead, the two indicators could conveniently be coupled together, one on either side of the bulkhead; as, in this case, connection by shafting to the port and starboard engines need only be made to one of the two indicators. The direction of rotation of the pointer indicates the faster engine. The right-hand shaft is joined by shafting to the starboard engines; the left-hand shaft is joined by shafting to the port engines. When both engines are running at equal speeds, the pointer will remain stationary opposite the indicator mark. If the starboard engines are running faster, the pointer will move round in the direction indicated on the dial shown in the photograph. If the port engines are running faster, the pointer will move round in the opposite direction, as indicated on the dial. The small arrow pivoted under the indicating mark is always pointing in the direction in which the pointer has moved away from the indicating mark. Lubrication is provided for all the moving parts, an oil syphon being fitted in the usual way.

It will be seen from Fig. 2 that the shafts to be connected respectively to the port and starboard engines each engage, by means of bevel gearing, with a differential bevel gear, whose bevel pinion is mounted on an arm which is pinned to a spindle, to the end of which is fixed the pointer. An auxiliary pointer acts as the "indicating mark," and is fixed, behind the dial, to a crown wheel gearing with a pinion on a spindle, which is actuated by a knob on the outside of the instrument. This arrangement enables the "indicating mark" to be moved round the dial opposite to the pointer when necessary. The small auxiliary arrow pointer, which can be seen in Fig. 1, but which is not shown in Fig. 2, is pivoted under the "indicating mark," and has a cam attached to it behind the dial worked by a spring lever. At the back of the pointer is a spring pin or tooth, which engages in a hollow in the back of the arrow pointer in such a way as to leave it pointing in the direction in which the pointer has moved away from the "indicating mark."—We are indebted to London Engineering for the above description.

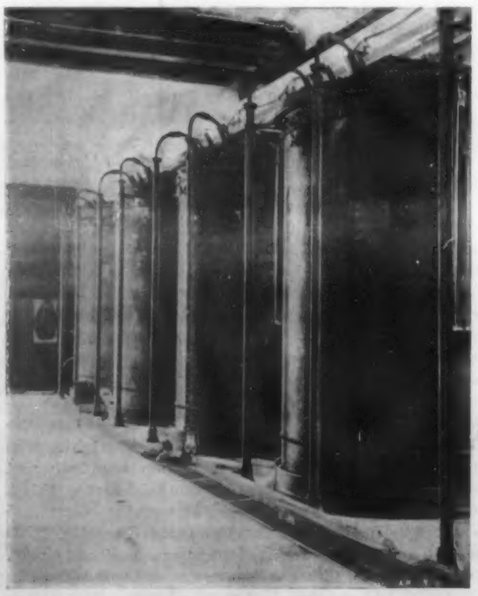
Restriction of Penny-Ice Trade.

The London Lancet sounds a note of warning concerning penny-ices, the number of peddlers of this delicacy being about as numerous in the British metropolis as in this country. The penny-ice man is usually an Italian who is anxious to return to his own country after ten or twenty years' hard work, and become a land owner. In order to do this he is compelled to live in unsanitary surroundings where there is every risk of contamination. The Public Health Committee of the London County Council recently brought out a report, which was adopted by the Council, recommending legislation forbidding the manufacture, sale or storage of ices in any cellar or room in which there was an inlet or opening to a drain, or in any other place where there is any risk of contamination or infection. A failure to notify in case of infectious or contagious disease occurring among persons employed in this place would lead to summary conviction and the infliction of a fine. Finally, every vendor must exhibit on his barrow a notice giving the name and address of the persons from whom the ices have been obtained. Many ices are made in small backyards of overcrowded tenement houses, and the conditions are as unsanitary as when the ices are made in an unhygienic room. From the public health point of view, it would be a great advantage if the ices were made in large and properly arranged establishments. Aniline colors are freely used in tinting the ices.

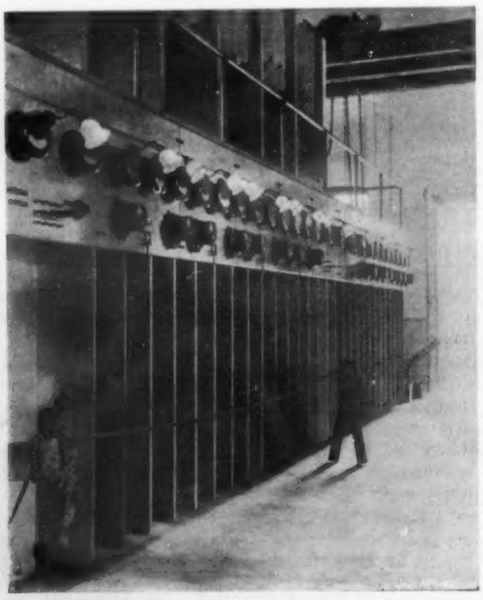
The chimney of the Oxford copper works at New Brighton, Staten Island, is 365 feet above the ground.



Time Limit Relay, Circuit-Breakers and Switches.



Transformers.



Distributing Board.

TERMINAL STATION AT BUFFALO.

BURNING THE SIERRA MADRES.

BY CHARLES F. HOLDER.

The Sierra Madre Mountains from the vicinity of Mojave to San Diego have an important bearing upon what is to all intents and purposes the great American oasis, Southern California, being a fertile section between the Desert of California on the east and the ocean to the west. Stranger or more antipodean conditions are rarely seen in such close proximity, the mountain range forming the line of demarkation between one of the garden spots of the world and the greatest desert in America. From the summit of Mt. San Antonio, which is one of the sentinels of the region, the climber can by a mere turn of the head, a sweeping glance, take in all this wonderful country of extremes; or he can face the south and west and see both conditions at once. To the east are the burning sands of a region given over to the elements, the sandstorm, mirage and intense heat that in some localities, as Death's Valley, is almost intolerable, and death to man or beast caught in its toils without water. To the west the eye falls on the Southern Californian oasis, a small green strip on the ocean slopes of the mountains, abounding in groves of lemon, orange, vineyards, orchards of all kinds—a striking and remarkable contrast. The latter are possible on account of the water on the south slopes of the Sierras, which falls in the great watershed of the range from twenty to forty miles wide, and finds its way down to the Valleys of San Gabriel, Pomona, San Bernardino, Redlands, San Fernando, Santa Clara and others.

Originally the mountains were covered with a thick growth of chaparral, greasewood, manzanita, wild lilac, brush oak and many more growths, while the north slopes bore large oaks, spruces, and the cañons cottonwoods, bay, sycamore and others. The leaves and natural decay of this covering formed that essential for rain holding, an upper crust of dead vegetation which retained the water allowing it to slowly trickle down the mountain side and soak into the ground. Such was the normal condition, and fifty years ago the forests abounded in large trees and the valleys in attractive groves of live oaks of several kinds. Since the growth of towns and cities along the foothills the mountains have been devastated in every direction. Campers build fires and go off and leave them, and every year, for the past sixteen in the writer's knowledge at least, large fires have raged.

This has been particularly true in the last five years. Fires have caught on the valley side, swept up the mountains denuding the slopes of every bush and weed, leaving the barren rocks to alone tell the story. Opposite the city of Pasadena a huge blemish is seen on the face of the mountains. A vast acreage of the Sierra Madres has been fire-swept, and mile after mile of cañon and forest has been destroyed. The fires, especially in September, spread rapidly, the columns of smoke rising several miles into the air, forming a marvelous and majestic spectacle. The sun blazing upon this changes it into molten silver, while the flames from below color the lower portion with all the tints of red, scarlet, yellow and vermilion, while below this again masses rolled upward as from a volcano—black, brown, burnt umber and all the somber shades, producing a color scheme beyond the conception of the artist. The sides of the mountains for miles are seething yellow flames, at night presenting a brilliant spectacle, sweeping up the mountain side with the roar of a cataract, cutting out densely wooded cañons, leaping gulches — incredible spaces — and laying waste the entire section of country.

The repeated occurrence of these fires finally aroused the people of Southern California to the fact that the water supply, upon which everything depends, was threatened. When the rain came a stream as black as ink swept down the Arroyo Seco for days and weeks, showing the extent of the burned area and emphasizing the fact that the water was rushing down the mountain side carrying with it the charred remains of the verdure which once covered it. It was evident that some definite and systematic method of fighting fire was necessary. The volunteers soon gave out, and as a result a force was organized under the direction of the forester of this section and a plan of action decided upon; but it came too late to save the best portion of the mountains. Now lines of white can be seen leading over the cuts after a snowstorm; these are the fire trails built by the fire fighters, first, to enable the men to ascend the mountains quickly, and, secondly, to aid in staying the flames, the barriers running across the range cutting off the fire from below.

FOREST FIRE IN THE SIERRA MADRE MOUNTAINS.

These trails are from ten to twenty feet wide, the vegetation being entirely cleared away.

By thus systematizing the work a gang of from one hundred to two hundred men can successfully combat the largest fire. The fire has made serious inroads from San Francisco down, especially at Santa Barbara; the mountains known as the Santa Iñez have been burned over many times, and on one occasion the Lick Observatory was saved only by the herculean efforts of Dr. Holden, then director, and a corps of volunteer fire fighters.

In the Sierra Madres the fires will continue every year, as in summer hunters, campers, fishermen and prospectors are in every cañon; many camps and small hotels in the interior of the range are liable to be cut off. The camps of Mt. Wilson, and even the hotel at Mt. Lowe have been in danger several times, but in the future these and other resorts will be well guarded.

EAST INDIANS IN THE ISLAND OF TRINIDAD.

When slavery in the British West Indies was abolished the sugar planters experienced a severe struggle with the labor problem. The negroes, when freed, refused to work in the cane fields, and it at once became necessary to get a fresh supply of labor from some other source or abandon the sugar colonies. Consequently the importation of coolies from India was resorted to. Agents of the British government were sent to Calcutta to arrange for the exportation of laborers. This exportation, which continues to the present time, as the planters demand, was made by an indenture with these coolie immigrants, by which they are bound to work for a term of five years on the plantation to which they are assigned by the government. In order to avail themselves of the use of this labor, the planters are obliged to execute a contract with the colonial immigration authorities, agreeing to provide food, clothing, lodging and medical attendance and to pay them 6 pence (12½ cents) per day each for their labor. The laborers are bound to work six days of 7½ hours each in every week. At the expiration of the term of five years the contract can be renewed if the laborer desires it, or he may have a free passage back to India. A fine of a day's pay is levied on the laborer for each and every day he neglects to do his bounden duty. The Colonial Government authorities reserve the right to remove the laborers from any plantation if they are not properly treated.

EAST INDIAN COOLIE WITH HIS DONKEY.

The East Indians that immigrate to these colonies are either Mohammedans or Hindoos. The various caste distinctions are not easily defined by the uninitiated, but are as carefully observed as in their native country, and the smallest infringement is a deadly sin; and, although crossing the ocean degrades all Hindoos, the castes still keep their relative distances and never sink to the same level. The Mohammedans reverence two Persian saints, Hassan and Hosien, and an annual religious festival is held each year. The accompanying illustration represents this celebration in the Island of Trinidad. Hassan and Hosien were the sons of Ali, a Persian Caliph, and his favorite wife, Fatima, daughter of

MOHAMMEDAN RELIGIOUS FESTIVAL OF EAST INDIANS IN THE ISLAND OF TRINIDAD.

Mahommet. Ali was assassinated by a fanatical religious sect, and was succeeded by Hassan, who was murdered and the throne usurped. Hosien later led a revolution to regain the Caliphate, but was slain in battle, and in honor of these men these festivals are held. They consist of religious ceremony and mystic rites, and at times they become fanatical and torture themselves with burdens and slashes with knives. The miniature mosques seen in the picture are built of bamboo and tinsel paper, and are carried about the streets on their shoulders.

The East Indian coolies, as seen in this island, are physically well-shaped, with regular features, straight black hair, and aside, from their dark brown skin, have a similar appearance to the Europeans, belonging, as they do, to the Aryan race, from which all Europeans descended. The coolies are happy in Trinidad; most of them are industrious and thrifty, and many of them at the expiration of their term of indenture have saved some money, and they buy land or go into trade.

The coolie will not intermarry with the negroes. The negro regards him as an inferior; the coolie, however, knows his position. He is proud of his ancestry and the ancient civilization of his race. At the present time the East Indians comprise fully one-third of the population of the island. That the commerce of the island is benefitted by the importation of these coolies is shown by the fact that the export of sugar has increased five-fold. The only opposition met with is from the negroes, who fear the industry and frugality of the Indian immigrant.

Engineering Notes.

Important deposits of copper have been discovered in Siberia. It is thought that these mines will be sufficient to supply a considerable amount of the Russian demand for copper.

A brass wire screen in a stamp mill lasts from two to three weeks, and during that time from 200 to 250 tons of crushed quartz rock pass through it. A punched steel plate lasts much longer, and from 300 to 500 tons of quartz can be passed through it.

A steamship line is proposed between Java and America, calling at Chinese and Japanese ports. The projected line belongs to the Royal Packet Company. Should this route be opened San Francisco will be the American port of call, touching probably at the Hawaiian Islands.

The proposed ship canal between St. Petersburg and the White Sea is of considerable importance. The naval port of Cronstadt, which protects St. Petersburg, is to be connected with the new naval harbor, Sorotskaja, on the White Sea, by a canal of sufficient breadth and depth to admit the passage of Russia's largest cruisers. The extreme depth will be 31 feet and the water surface will have a breadth of 200 feet. The canal is 602 miles long and its course is as follows: From the river Neva to Lake Ladoga, across the lake to Svir River, the entire length of this stream to Lake Onega, thence due north to a new canal to Sego Lake; again by canal to Vigozero Lake, and thence to the Gulf of Onega and the White Sea. It will create cheap transportation for timber and grain, and will cause the establishment of saw and grain mills. With her contemplated canal and the Trans-Siberian Railroad Russia is well provided for in case of war.

A most extraordinary incident occurred at Mare Island Navy Yard on the 5th of June in which over 600,000 pounds of explosives were consumed at one time, but without causing any damage whatever except to the premises in which the explosive was stored. That such an amount of powerful explosives could be destroyed in a thickly populated community without causing widespread desolation is a marvel that is puzzling military and naval officials greatly. The fire was discovered at 6 o'clock in the morning. There was no shock or explosion. The first thing noted was the ascent of an enormous column of smoke or vapor, in shape like a balloon and possibly 2,000 feet in height. The roof of the magazine, constructed of thin sheets of iron, was raised above the supporting walls and torn out of all shape; but the building itself, constructed of stone with walls four feet in thickness, was not seriously injured. With the roof restored it will be as good as ever. As yet no one knows the cause of the fire. It occurred at a time when no person was in the magazine. The theory is that decomposition and spontaneous combustion took place. A board of inquiry has been appointed to investigate. The magazine was isolated; but just over a ridge was the residence of the officer in charge, which was not disturbed. Not a hundred yards away was the house for storing shells, which remained intact; while within 500 feet of the magazine was stored 800,000 pounds of black powder, which was unaffected in any way. The powder destroyed is believed to have been a lot of prismatic brown, of which a very large quantity was ordered by the government during the war with Spain and was considered obsolete, being used only for saluting.

RAILROAD TRACK NUT-LOCK.

In spite of the great amount of thought and expense that has been lavished upon the rail joint, it is to-day a most unsatisfactory feature in railroad track, and one that demands unremitting care on the part of the section gang. Much of the trouble is due to the tendency of the angle-bars to become loose, owing to the slackening up of the nuts on the screw-bolts. Many attempts have been made to remedy this, especially by the use of some form of spring nut-locks.

The accompanying illustration shows a very practical method adopted by the inventor, Mr. S. S. Jamison, of Saltsburg, Penn., for overcoming these difficulties, by providing a nut-lock which would be incapable of displacement when it once had been set up. The bolt itself differs from the ordinary bolt in the fact that the shank is not threaded, but, instead, has an axial hole bored in the end of it. The nut has a hole which fits closely on its inner end to the bolt, and increases in diameter toward the opposite face by a succession of independent steps, which have between them sharp detent edges. After the bolt is put in place through the fish-plate of the rail, the nut is slipped on with the smaller orifice next to the fish-plate, and a tapered tool is then inserted in the axial hole at the end of the bolt, and a blow from a sledge hammer on the tool serves to expand the end of the bolt until it fills the larger opening on the outside of the nut. The metal of the bolt is spread into these steps, and each shoulder between the steps forms a sort of detent that is tightly and closely buried into the metal of the bolt so that the bolt and nut are held snugly together. For applying the nut-

RAILROAD TRACK NUT-LOCK.

lock a special inverted U-frame is provided, which has one end forked to receive a pivoted cam. The cam is operated by the foot of the sectionman, and when depressed, as shown in our cut, serves to press home against the head of the bolt a cup-shaped angle-piece. The opposite end of the U-frame is perforated in line with the angle-piece, and carries a tapered expanding tool. When the clamping device has been adjusted and the cam-lever is depressed, the nut is brought snugly up against the angle-bar. A sharp blow from the trackman's sledge serves to drive home the expander and swell the metal out into the nut as above described, locking it permanently in place. Rails and fish plates are all drawn to place.

Ambassador White, of Berlin, reports that no final agreements upon the question of rendering the River Main navigable to vessels of greater tonnage has been reached. This measure, in connection with the extensive canal-construction bills, has been twice before the Prussian Diet. The plant is dependent upon the city of Hanau agreeing to build a harbor of refuge, and this it has not yet done. In this connection, it is of interest to note the growth of traffic on the canals of Germany since 1872, taken from the official statistics. The traffic in 1899 on the Ober-Elbe, at Entenwaerder, amounted to 2,959,000 tons, against 1,940,000 tons in 1895 and 1,550,000 tons in 1891. The traffic on the Spree, at Berlin, amounted in 1899 to 2,901,000 tons upstream, against 2,753,000 tons in 1895, and to 2,131,000 tons downstream in 1899, against 1,888,000 tons in 1895. At Mannheim, the Rhine traffic in 1899 was 3,462,000 tons upstream, against 2,436,000 tons in 1895.

Correspondence.

The Brooklyn Bridge Accident.

To the Editor of the SCIENTIFIC AMERICAN:

Your article on the East River Bridge was read with much interest by me. In connection with your suggestions for improvement of the structure let me ask what is the objection to carrying that part of the bridge supported by the short rods on rollers, either at the cable end or the floor end. I mean rollers between plates. The cables at that point are practically level, and I can see no difficulty in putting a longitudinal saddle on top of the cable, having a flat top, upon which might rest in turn a movable channel resting on rollers. To this latter could be attached the rods, which then could be fastened to the floor beams without the intervention of the trunnion blocks.

The pendulum action of the suspender rods necessarily shortened them and in consequence required them to pull up the floor at that point, while at the same time the longer suspenders away from the center of the bridge were expanding by the heat, allowing it to drop. The floor being stiffened by trussing, and this time refusing to buckle as it has on another occasion, the rods gave out. T. W. MOORING.

26 East Main Street, Waterbury, Conn.

The Naval Programme for 1901.

To the Editor of the SCIENTIFIC AMERICAN:

In view of the fact that but two battleships and two armored cruisers are to be asked for at the present session of Congress, it will be remembered that last year Congress did not authorize the construction of any battleships or armored cruisers; therefore, the above ships to be asked for are really what should have been last year's appropriation. Such being the case, an appropriation much larger should be asked for, in order to bridge the gap of one year's delay.

While we have greatly profited by the compulsory delay by having had time to observe the behavior of our newest ships, besides having obtained a great deal of useful knowledge from experimental work in the model tank at the Washington Navy Yard, we have, in fact, lost a great deal more than a year's time owing to delays in shipyards on vessels just completed or under construction, due to strikes or failures of the government to deliver armor on time.

When we consider that Germany has about the same number of ships as the United States, and that she has in addition a fixed shipbuilding programme, it will be realized by those who take interest in the development of our navy that even a delay of one year means a great deal, both as regards the strength of our fleets and the moral effect upon our officers and men, who have no programme to look forward to, but must be satisfied with piecemeal appropriations from Congress.

Therefore, we suggest that three battleships and five armored cruisers be asked for, thus adding one battleship and three cruisers for this year's appropriation.

Germany will be the watchword of our future naval development. We have a position in the rank of naval powers which is quite sufficient; we do not need to be any higher up, but we cannot afford to let another naval power pass us on the road of naval development.

Objection may be made to the suggestion to increase the appropriation on the ground that our private shipyards are overcrowded; that some firms have too much government work already on hand. However much work the shipbuilding plants now have on hand we feel sure that if a foreign government were to negotiate for the construction of warships in American shipyards they would meet with little difficulty in having them constructed here. Furthermore, the government yards are now capable of constructing vessels. Armored vessels could be built at the New York Navy Yard, which now has admirable facilities for such work. Smaller vessels could be constructed at other government yards, thus relieving the private yards of such light work, while at the same time affording them more room to devote to the construction of armored vessels. That our private shipyards have all they can do was said a year or two ago when two vessels were under construction for Russia and two more for Japan.

Let Congress appropriate vessels sufficient in number and power to keep our navy always ahead of the one next in rank, and then, by the faithful work which the various bureaus of our Navy Department put into those ships, and the faithfulness with which our officers and men work under difficulties, we need have no doubt but that in a short time the fighting strength of our navy, as compared with the number of vessels composing it, will show a higher percentage than a like comparison of our rivals will show.

CARLOS DE ZAFRA.

New Milford, Conn., August 3, 1901.

The production of steel wire nails in the United States in 1900 was 7,233,979 kegs.

THE WHITE STAR LINER "CELTIC."

Of late years the development of the transatlantic liner has proceeded along somewhat divergent lines, and has resulted in two distinct types, of which the "Deutschland," of the Hamburg-American Line, and the new "Celtic," of the White Star Line, may be taken as the most recent representatives. At one time the transatlantic merchant steamers were divided sharply into two classes—one intended primarily for the carriage of passengers and mails, and the other for carrying freight only. The demand of late years for passenger accommodation that should be cheaper and not so luxurious as that of the mail steamers led the companies to provide, on the faster of the freight steamers, a certain amount of passenger accommodation; and the new departure has proved so successful that an entirely new type of steamer has been produced, of which such ships as the "Pennsylvania," "Cymric," "Ivurnia," and now the "Celtic," are the largest and most popular representatives. Although these vessels are primarily to be considered as freighters, the extent and quality of their passenger accommodation, and the high average sea speed of from 14 to 16 knots of which they are capable, renders them scarcely less valuable to the owners and to the traveling public as passenger ships.

The element of bigness enters so largely, in these days, into the notoriety of ocean steamers, that the advent of the "Celtic" to the port of New York must be reckoned one of the most notable events in the history of transatlantic navigation; and since the "Great Eastern" is the invariable basis of comparison, we may state at once that the new vessel is 9 feet longer than that ship, about 1 foot deeper from the same deck, and of 10,700 tons more displacement. Another vessel with which the "Celtic" may be compared is her predecessor, the "Oceanic." The "Oceanic" is 4 feet longer and of the same depth, but her other dimensions are considerably less than those of the new boat. The accompanying table will enable the reader to compare the new vessels with other notable liners that are at present in service:

Name of Ship.	Date.	Length over all.	Beam.	Depth.	Displacement.	Gross Tonnage.	Speed.
		Feet.	Feet.	Feet.	Tons.	Tons.	Kn'ts.
Great Eastern........	1858	692	83	57½	27,000	18,915	14½
Paris................	1888	560	63	42	15,000	10,500	20
Teutonic.............	1890	585	57½	42	13,800	9,984	20
St. Paul.............	1895	554	63	42	16,000	11,600	21
Lucania..............	1893	625	65	41½	19,000	12,950	22
Kaiser Wilhelm.......	1897	649	66	43	21,000	14,349	22.8
Oceanic..............	1899	705	68	49	32,500	17,274	21
Deutschland..........	1900	686	67	40½	23,500	15,500	23.5
Celtic...............	1901	700	75	49	37,700	20,880	16

The "Celtic" is 700 feet long over all, has 75 feet of beam and 49 feet of depth, measured from the keel to the promenade deck, the plating of the vessel being carried up to this deck continuously throughout the whole length of the vessel. At present her maximum draft will be about 31 feet, this being the limit imposed by the present depth of water at the entrance of New York Harbor; but she has been designed with a view to the larger accommodation which will be afforded by the 40-foot channels which are now being dredged by the United States Government. When these are completed, the "Celtic" will load to her maximum designed draft of 36 feet 6 inches, and at this draft she will displace the enormous amount of 37,700 tons. Displacement, or the total dead-weight of ship and load together, is of course the truest test of a vessel's size. Just how big this new marine giant is may be judged from the fact that at 37,700 tons displacement she will weigh in the water just double as much as the largest battleship now built or under construction. She will, as we have said, exceed the "Great Eastern" by 10,300 tons, and she will even exceed the great "Oceanic," at the maximum designed displacement of that vessel, by 5,200 tons. At the present writing there is lying in the adjoining dock of the White Star Company, at New York, the company's steamer "Germanic"—a mighty ship in her day. It would take four and one-half times the total displacement of the "Germanic" to equal that of the "Celtic."

Although we have given the depth of the "Celtic" as 49 feet, as a matter of fac the topmost deck of the ship will be just 100 feet above the keel; that is to say, when the vessel is loaded to say 30 feet, the captain will stand on the bridge at an elevation of 70 feet above the sea level. Reckoning from the keel, we have first the floor of the vessel, which forms the inner bottom of the cellular "double-bottom" of the vessel. Next above this is the lower orlop deck; then in succession follow the upper orlop, the 'tween deck, the main, upper promenade, bridge, upper bridge, and the sun deck, the last-named being at the same level as the captain's bridge, or 100 feet above the keel. The first six decks to the promenade deck are continuous throughout the vessel. The bridge deck above this is broken in places for convenience in reaching hatchways. The upper bridge, boat deck and the sun deck extend for about one-third of the length of the vessel amidships, and on these decks is located most of the cabin passenger accommodation.

In the construction of a ship of this great length and carrying capacity, extra provision had to be made for longitudinal strains, to secure her against the alternate hogging and sagging stresses to which she is subjected. Among other provisions for strength is the doubling of the bilge strake amidships, while the sheer strake and the next but one below it are also doubled. The upper deck stringers have been doubled, except at the extreme ends of the vessel. Fore-and-aft strength is secured also by six longitudinal members, worked three on each side of the keel, intercostally. There are also two intercostal keelsons. As a further provision for strength there is a beam at the decks to every frame of the vessel. There were used in plating the ship 1,392 plates, which averaged 5 feet in width by about 30 feet in length. They were as much as an inch and a quarter in thickness, and weighed in some cases four tons apiece. In riveting up the structure, close upon 2,000,000 rivets were employed. The engines are of the Harland & Wolff's quadruple-expansion, balanced type, the cylinders being 33, 47½, 68½ and 98 inches in diameter, with a common stroke of 5 feet 3 inches. Steam is supplied by eight double-ended boilers, each 15 feet 9 inches by 19 feet 6 inches, and the trial speed, when the engines are working up to the full horse power is 17 knots per hour. The sea speed of the vessel will average something over 16 knots an hour.

In spite of the fact that the "Celtic" can stow away 18,500 tons of cargo, including 2,400 tons of coal, passenger accommodation of an exceptionally spacious character is provided for 2,859 passengers. Of these, 347 will be first-class, 160 second-class, and 2,352 third-class. The last-named will be accommodated on the upper, main, and 'tween decks—some of these in separate staterooms and others in open berths. The officers, as is customary in White Star liners, will be housed on the upper bridge deck. There will be a deck crew of 64, an engine-room and stoke-hold staff of 92, and 179 stewards, making a total crew of 335. Adding this to the number of passengers, we find that the total number of souls aboard the "Celtic," with a full passenger list, will be 3,194.

An interesting comparison of the "Celtic" and the "Oceanic" is that based on the coal consumption as compared with the passenger accommodation. The "Oceanic" carries 1,284 fewer passengers, and, as we have said, her maximum displacement is smaller than that of the "Celtic" by 5,200 tons. Yet, to secure her additional speed of four knots an hour she burns double the amount of coal and requires 115 more men in her crew.

Our illustrations of the vessel speak for themselves. We draw particular attention to the bow and stern views, taken when the mammoth ship was in drydock, which afford a most vivid impression of her vast height and bulk. The interior view of the front cabin dining saloon, which is 75 feet in width, shows that in spaciousness and comfort the "Celtic" compares favorably with costlier vessels.

Electrical Fire-Damp Indicator.

A novel fire-damp indicator, based upon the method of electrical resistance, has been devised by M. G Léon. The indicators in use at present are based upon the halo given by a flame in the air containing fire-damp. Ordinary oil safety-lamps will only indicate down to 2 per cent, but M. Pieler, using the larger flame of alcohol, has brought the limit down to 2 or 3 thousandths. M. Chesneau dissolves nitrate of copper and bichloride of ethylene in the alcohol and gives a blue flame to the Pieler lamp, which reveals as low as one thousandth part of fire-damp. Mr. Livéing, an English engineer, has devised an electric indicator based on the difference in redness of two platinum wires heated by the same current and placed in pure and in contaminated air. This method will show about one-half per cent. In the present method M. Léon uses instead the difference of electric resistance of two platinum wires heated to about 1,000 deg. C. by the same current. One of the wires is stretched in a sealed glass tube, and the other (for the fire-damp) placed in a wire-gauze case. The two wires form the two branches of a Wheatstone bridge, the other two branches being formed of suitable resistance wires, in this case of 1.3 ohms each. For the galvanometer of the bridge a Chauvin & Arnoux instrument was used, giving a deflection of 100 divisions for 50 milliamperes. Two cells of accumulator give the current, and the resistances are adjusted till the needle remains at zero when both wires are in pure air. When the air contains fire-damp the galvanometer is deflected 2 divisions for one-thousandth part of fire-damp. These deviations are about proportional to the quantity of gas. The author concludes that with this indicator the proportion of fire-damp in a mine may be determined at any instant, and that it will even be possible to establish fire-damp observing stations, and thus contribute greatly to the scientific study of the subject.

Compressed Air for Pumping Oil Wells.

One of the latest and most novel uses to which compressed air has been put is the pumping of oil wells. California has oil fields throughout its entire length, but of these what is known as the Bakersfield or Kern River District, situate about the middle of the state, is head and shoulders above all the others, both as to present production and possible developments. In this district the formation lies almost horizontal and, with the exception of a sticky clay and heaving sand, is just hard enough to drill rapidly, but the heaving sand has been so difficult to overcome that in many cases wells that, from their surroundings were absolutely sure of oil, have, after months of constant effort, been abandoned on account of the heaving sand. It certainly requires courage and persistence in the drillers, after working for days and perhaps only gaining ten or fifteen feet, or possibly nothing at all, to run his tools into the hole and find that they will not go down within one, two or possibly three hundred feet of what they had gone but a few minutes before; and to have this experience day after day and week after week will test every virtue a man may possess, including his pocketbook.

Every expedient known in other fields has been tried here, but with only moderate success. The formation being loose and open allows the water to run away so fast that the rotary hydraulic rig is a failure, though where the sand heaves *inside* the casing a column of water is used with good effect to aid in holding it back. Even after the oil sand has been reached and the pump put in, the troubles have only begun, as the pressure outside of the casing forces the sand through the perforations and the well has to be shut down at short intervals to remove the accumulated sand and clear the working barrel, necessitating an engine and rig at each well and also the retaining of a "pulling crew" of at least three men.

To overcome these conditions a great deal of expensive experimental work has been done by various companies, and at this time compressed air gives promise of solving the problem. The air is piped from the air compressor (too well known to need any description) to the well, a 1-inch pipe run down into the well and connected with a 3-inch tubing near the bottom by a U joint, though in some cases two or three pipes are connected, one at the bottom of the tubing, one at about three-quarters distance down and one about one-half the distance. In starting the well pumping they are all turned on together until the column of oil is started, when the intermediate connections are shut off and the lower one will do all the work, usually requiring about 120 pounds pressure in an 850-foot well, 14 gravity oil. By this method everything above the connections is carried out of the tubing and the deeper they are submerged the better the results. In this way the sand, which has been the source of so much trouble, is not allowed to accumulate, but is carried out with the oil, and by gradually lowering the tubing the well is cleared of whatever sand may have accumulated in it. In one instance which has come under our observation the well, after being completed, had filled up 180 feet with sand which, working day and night for nearly six weeks with the tools, failed to lower. As an experiment and last resource compressed air was introduced with the result that in four days, besides getting the benefit of the entire production of the well, the sand had been removed and the tubing lowered to the bottom of the hole and the well has since produced steadily.

Briefly, the advantages of the new method are as follows: One man to attend to the compressor plant and one man to attend to all of the wells being pumped, instead of one man to every well and a pulling crew in addition.

The compressor plant being the only machinery required, instead of an engine and rig to every well, wells can be operated at a long distance from the compressing plant with practically no loss of power. Last, but possibly most important, the wells produce for thirty days in the month instead of about fifteen days, as heretofore.

Dome of St. Paul's Cathedral Damaged.

The dome of St. Paul's Cathedral is badly cracked and the damage is serious. The immense weight resting upon the eight piers upholding the dome has caused the foundations under the dome to settle more than elsewhere. This has broken eight arches and the windows of the clerestory over them in the nave of the choir, and in the north and south transepts where they abut on the dome piers. The great weight of the western towers has caused them to sink, and in sinking they have cracked the west front vertically through the great door, the window above and the vaulted ceiling and portico. Minor cracks have been noticed. The architect in charge of the difice is of the opinion that the damage was caused by the settlement induced by the building of two underground railways and a large sewer. The vibration of the trains is considered particularly harmful.

THE ERECTION OF THE GOKTEIK BRIDGE.

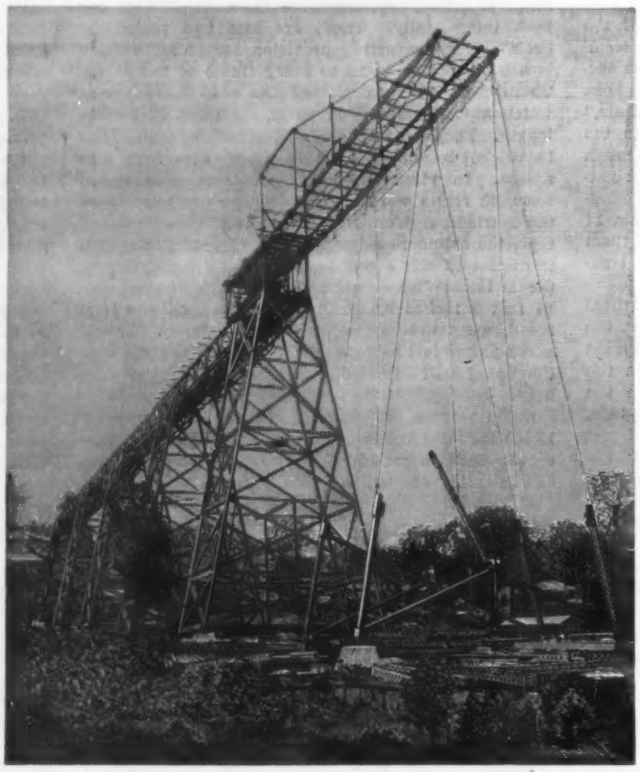
BY DAY ALLEN WILLEY.

What is known as the Gokteik Viaduct, recently completed in Burma, Asia, is notable for its height, length and the remarkably short time in which it was built, considering the obstacles to be overcome. As the bridge was planned and the material made in this country, and most of the important work was done by Americans, it forms another indication of the progress which our bridge-building industry is making abroad. The structure, which is located about 80 miles from Mandalay, connects portions of the line of the Burma Railway Company between Mandalay and Rangoon. It is one of the long railway bridges of the world, being 2,260 feet in length, and, with two exceptions, it is the highest, the railway track being 320 feet above the natural bridge which forms its foundation. The famous Loa Viaduct in South America is 336 feet high, but only 800 feet in length. The Pecos Viaduct in Texas is 321 feet in height, but 80 feet shorter than the Gokteik structure, while it contains but 1,820 tons of metal. The new Kinzua bridge on the Erie Railway in Pennsylvania is but 2,035 feet long and 19 feet lower at its highest point, although it contains 3,250 tons of metal.

The erection of the bridge was begun December 1, 1899, and completed on October 16 last, the construction force consisting of 35 employes of the Pennsylvania Steel Company, which took the contract; 15 Europeans, and about 450 native laborers, secured principally from the vicinity of Calcutta, India. The plans, which were prepared by Mr. J. V. W. Reynders, superintendent of bridge construction of the Pennsylvania company, called for a series of 14 single towers, one double tower, and a rocker bent, which, with the abutments, carry ten 120-foot truss spans and seven 60-foot plate-girder spans. The viaduct, for 281 feet at one end and 341 feet at the other end, is curved to a radius of 800 feet, and between these two curves there is a tangent of 1,638 feet. The height of the structure above the ground is 130 feet at one end and 213 feet at the other end. The viaduct was designed to carry a double-track road and a footwalk, but the floor system for the footwalk and one track only is constructed at present. The single towers consist of two transverse trestle bents, braced together in all directions. The double tower consists of three trestle bents. So far as practicable, the members of all bents were made interchangeable.

Except seven plate-girder spans, located at the ends of the viaduct, all of the connecting spans are made up of two 120-foot deck trusses. These trusses carry 27-inch plate-girder floor beams spaced 13 feet apart, which in turn support the track stringers. The top flanges of the trusses, floor beams and stringers are made flush, and are covered over with a solid floor of 5-16 inch flat plates.

To handle the material a special traveler was designed and constructed at the works of the Pennsylvania company, shipped to Asia with the bridge material, and put together at the gorge. This is by far the largest traveler ever built, having an overhang of 165 feet and weighing 80 tons. Its maximum lifting capacity is 30 tons. It consists of 3 trusses, two of which are connected by transverse bracing, built on the cantilever plan, each being 219 feet in length, 40 feet in height, and separated by a width of 24½ feet. The lower chords of the traveler supported four trolleys, each provided with a chain hoist having a lifting capacity of 16 tons. Powerful clamps were especially designed for holding the rear end of the traveler to the girders of the viaduct, and it was supported on a series of wheels enabling it to be easily moved as the work progressed. Most of the material was lowered from above by the traveler. In erecting the towers crossing the deepest portion of the gorge a temporary track



TRAVELER SUPPORTING COLUMNS DURING TOWER CONSTRUCTION.

was built on a wooden trestle at an elevation of about 100 feet above the base, and material for the lower parts of the towers hauled to the spot and transferred to their positions by special derricks.

An idea of the quantity of material placed in position can be gained when it is stated that it comprised most of the cargoes of three steamships, and when loaded on the cars at Steelton, Pa., represented a solid train 1½ miles long. The erection plant alone weighed 250 tons, and, in addition to the traveler, included three hoisting engines, a series of air compressors, a telephone system for communication between the gangs working at each end of the viaduct, and the necessary chisels, hammers and other tools for bridge construction. At the outset heavy rains interfered considerably with the progress of the work, the violence of the storms being so great that it was seldom possible to do any work between noon and sundown. The temperature ranged from below the freezing point at night to over 90 deg. in the shade in the forenoon. Another delay was caused by the refusal of the native laborers, on account of their superstition, to use compressed air in riveting, and nearly all of this was done by hand, although the plans called for 192,000 rivets in the field work alone.

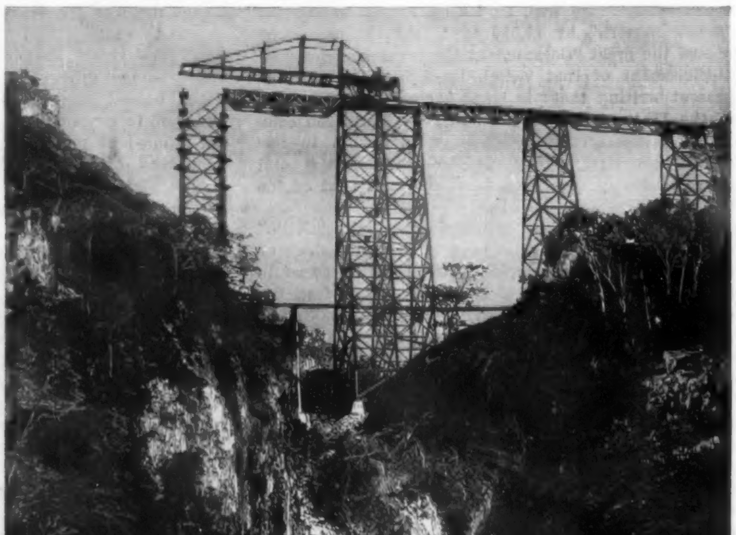
The usual plan followed in bridge construction, of indicating the locations of different parts by numbers and letters could not be followed in this case, owing to the ignorance of the natives; so a color scheme was adopted, by which each column and girder was given a distinctive color and the joints between the columns painted with a combination of stripes. All the erection outfit was painted black to distinguish it from the bridge material proper. In this way the thousands of pieces were handled and put in position without difficulty. In beginning the construction of the viaduct, the steel was hauled to the end of the track and deposited in a temporary storage yard in such a manner that it could be lifted by the traveler. Thus the first towers were erected. As these were placed in position, the superstructure was fastened to them and the traveler moved forward. Then the material was loaded on flat cars, pushed out upon the bridge, and transferred from the cars into position.

Owing to the height of the bridge, and the extreme changes in temperature, careful provision had to be made both for the wind pressure and the unusual contraction and expansion of the metal. The bridge was built to carry a load of 2,240 pounds to each linear foot of track, in addition to two locomotives, each weighing 54 tons. It is to withstand a wind pressure of about 34 pounds per square foot when a train is upon it, and about 56 pounds per square foot at other times. These calculations were made by the consulting engineers of the railway company—Messrs. Sir Alexander Rendel & Co., of London, represented by Mr. W. H. Clark. The viaduct was erected under the supervision of Mr. D. Duchars, chief engineer, and Mr. J. A. White, resident engineer.

As already stated, a portion of the viaduct is located upon a natural bridge. This is a rocky formation which is just wide enough to safely support the towers. Two hundred feet below its summit flows a river which has forced a channel beneath the formation, so that the total height of the bridge above the water is 520 feet.

Some interesting experiments have recently been carried out with the wireless telegraphy system of M. Victor Popp, whose work in compressed air and electrical engineering is well known. Col. Pilowski, of the Russian army, is associated with M. Popp in this invention. No tall masts are required and the system is terrestrial rather than aerial, the electric waves following the contour of the earth. The apparatus consists of two electrodes separated by a distance that varies according to the distance of the place with which it is desired to communicate. The negative electrode is placed on a sheet of glass to insulate it and the positive is buried in the earth at a depth of from twelve to fourteen feet. These two electrodes are connected with the transmitting apparatus. The receiving station is similarly equipped. M. Popp considers that the radius of his system is virtually unlimited. The experiments, however, have only been over short distances. He first devised a sort of reflector-insulator which allows of the electric waves being compelled to travel in a given direction.

VIEW OF TRAVELER SHOWING OPPOSITE SIDE OF GORGE IN THE DISTANCE.

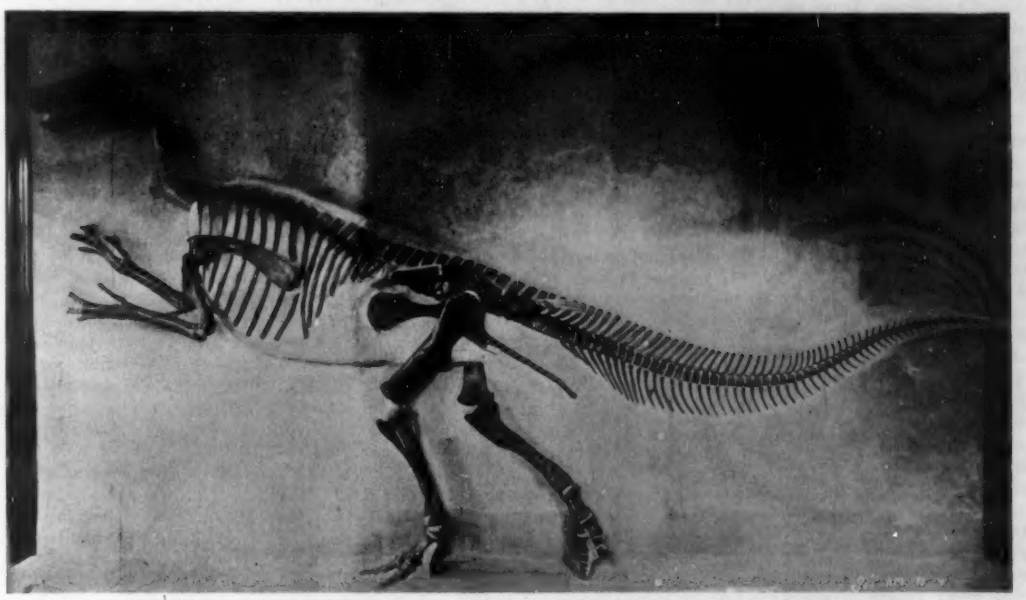


GORGE AND MAIN TOWERS WITH BRIDGE UNDER CONSTRUCTION.

YALE'S LARGE DINOSAUR.

The large dinosaur, on the restoration of which the geological department of Yale University has been at work for a long time, has recently been placed in position. The particular specimen which the Peabody Museum of Yale possesses is of the variety known as Claosaurus. It was discovered by Prof. J. B. Hatcher and a party of friends, in the summer of 1891, while exploring for the late Prof. O. C. Marsh, in the Laramie Cretaceous of Converse County, Wyo. The specimen was in excellent condition, and was a new variety; it was named Claosaurus annecteus Marsh. There is but one specimen in the world which can be compared to it; this is in Brussels.

The dimensions of the skeleton are as follows: Entire length of animal, 29 feet 3 inches; height of head above base, 13 feet 2 inches; height of shoulder above base, 10 feet; length of tail, 13 feet 7 inches; length of hind limb, 9 feet 5 inches. The task of mounting such a gigantic specimen was far from being an easy one. Parts of the skeleton were so firmly embedded in the rock that it was almost impossible to dig them out without injuring the specimen. As much as possible was removed, and the gaps were built out with cement, making a solid background of stone on which the skeleton stands out in bold relief. It is mounted in a position which suggests motion, with one hind foot lifted a bit from the ground, while the front limbs, which are considerably smaller than the hind ones, are in the air, showing that the creature was in the habit of propelling itself by means of its hind legs. The fore limbs are adapted for walking and support rather than for purposes of prehension.


MOUNTED SKELETON OF DINOSAUR, PEABODY MUSEUM, YALE.

As is often the case with the small fore limb of dinosaurs, three fingers of the hand of this specimen were used. The first was a rudimentary one, the second and third of equal length, while the fourth was shorter, and the fifth entirely wanting.

The hind leg has three digits, all well developed and massive. These limb bones, instead of being hollow, are solid, which tends to confirm the idea that the Claosaurus was fond of the water. The whole backbone of this creature, consisting of ninety vertebræ, is complete.

The difference between the Claosaurus and other dinosaurs is mainly in the shape of the head. The skull of this Claosaurus is long and narrow, and this specimen must have possessed an exceedingly small brain. In the case of the Anchisaurus—the dinosaur which is said to have frequented Connecticut—the skull differs in many ways from that of the specimen in the Peabody Museum. It is larger and of much more delicate structure, resembling in shape the New Zealand reptile called the sphenodon. Succulent vegetation was the chief article of diet of the Yale dinosaur.

The work of mounting the specimen was carried out under the direction of Prof. C. E. Beecher, to whom we are indebted for our photograph.

The British Antarctic ship "Discovery" left London July 31 bound for the Solent and, after being inspected by King Edward, will take her departure for her trip of four years' exploration in the Antarctic Circle. The "Discovery" is believed to be the best steamship for navigation in the polar regions ever built. No iron is used in her construction because magnetic survey work is one of the chief objects of the expedition. The vessel is constructed so that if ice closes in around her she will rise and clear herself away. If the rudder and propeller are threatened both can be hauled on deck. One of the curious features of the ship is a system of air-locks between the exterior and interior. This will prevent cold air from entering the vessel when persons go on deck or below. Capt. R. F. Scott, R.N., will command the "Discovery," and Prof. Gregory, of Melbourne, will be the director of the civilian scientific staff. The expedition goes out under the auspices of the Royal Geographical Society.

SELF-PROPELLING FIRE ENGINES.

BY WALDON FAWCETT.

For almost half a century inventors in this country have been experimenting with self-propelled steam fire engines. More than a quarter of a century ago the municipal authorities of Boston purchased such a machine because of the prevalence of disease among the fire department horses of the city, and a little later the New York department secured one of the same type, but of greater dimensions. The steering apparatus on these engines was not all that could be desired, however, and most of them were gradually abandoned, although one or two of the old-fashioned propellers are still doing duty in one of the smaller Eastern cities.

The automobile fire engines of the Boston department were built in 1897, and have been in continuous service since that time. They weigh nearly nine tons each and are, of course, much heavier than any of the engines drawn by horses; and yet experience has demonstrated that they may be handled and placed in position at a hydrant with less difficulty than a horse engine. The Boston engines answer second alarms from boxes in the dangerous district and are considered more reliable hill climbers in all weathers than horses.

The largest size automobile engines when at work at fires throw an average of about 870 gallons of water a minute, or 52,200 gallons an hour, while the average horse engine usually throws less than half that amount of water. Upon exceptional occasions when throwing two streams simultaneously horse engines have been known to play almost 600 gallons of water a minute, but it will be noted that even this quantity is well under that discharged by the self-propelling engine under normal conditions. However, the value of the propellers as fire-quenching agencies has been most conclusively demonstrated at hot and extensive fires where the streams from their one and three-quarter-inch or two-inch nozzles appear to have several times the effect of those from the one and one-quarter-inch nozzles of the horse engines.

Some truly remarkable showings have been made by the "auto" engines during tests. On one occasion one of the propellers played over 1,500 gallons of water a minute, or 90,000 gallons an hour, as compared with about 1,000 gallons a minute, or 60,000 gallons an hour, by the largest and most powerful horse engine procurable. On trials through 100 feet of hose the stream of water from the propeller was projected through a one and three-quarter-inch nozzle to a horizontal distance of 349 feet, and through a two-inch nozzle to nearly 320 feet, whereas a one and one-quarter-inch stream was thrown into the air to a height of 236 feet. When the streets are clear the self-propelling engines invariably distance all the hose wagons drawn by horses. The machines will readily attain a speed of a mile in three minutes, and at tests have shown speed above twenty-five miles an hour. Steam being the propelling power, is carried at all times on these big engines, and as a rule the horseless engine can be depended upon to be started on its journey to the fire within seven seconds after the alarm has sounded.

The working boiler pressure of such an engine as has been described is 125 pounds to the square inch, and, of course, the cost of constantly maintaining about 100 pounds of steam is considerable; yet it is declared in no case to be more than the cost of feeding three horses, and the officials of the city of New Orleans who recently made a careful comparison of the operating expenses of their self-propeller and a three-horse engine (allowing for the death of horses, etc.) found that the horseless engine cost but $27 a month, as compared with $60 a month for the machine drawn by animals.

There are at the present time seven self-propelling fire engines in actual service in this country, and that this class of apparatus is expected to grow in popularity is attested by the fact that several firms are now placing automobile hose wagons. The heavier first cost will, of course, hold against the self-propelling engines in some instances, but this would appear to be offset by the reduced operating expenses. Then, too, the self-propellers have demonstrated their ability to go through snow in which half a dozen horses could not have drawn the lightest engine. Indeed, their great power has sent the Boston "auto" engine through the worst snow blockades which have occurred in that city in four winters. Finally, the introduction of self-propellers sounds the knell of the unsanitary conditions prevailing in those engine houses where the firemen have been obliged to sleep in the same building with the horses.


AUTOMOBILE FIRE ENGINE IN BOSTON.

Export of Russian Crabs.

Consul Hughes writes from Coburg, under date of June 20, 1901: A small fresh-water crab, very much like a diminutive lobster, is largely imported into Germany and Austria from Russia. During the years 1896 to 1900, 75,000 cwts. were imported by Germany alone. Austrian imports amount to some 6,600 cwts. a year. Without very much trouble this industry might, I think, be introduced into the United States.

Automobile News.

At the recent Derby, the great annual English race on Epsom Downs, there were a large number of automobiles in evidence, and the number of four-in-hands were visibly decreased, showing that the automobile is making rapid headway in England.

Madame Schmahl, in the Nouvelle Revue, proposes motor-car kitchens, her idea being a kind of ambulant restaurant from whence food can be served ready for the table. She points out that some plan of this kind is actually in working order in Berlin, but there the ambulant restaurant only concerns itself with the preparation of food for the sick and ailing.

The City Council of Newport has decided to grant permission to the National Automobile Racing Association to use certain parts of the Ocean Drive on August 30 for automobile races. The petitions which were circulated met with hearty approval, and several hundred signatures were obtained. A number of imported racing machines will contest. The course is about 10 miles long, and the road is an excellent one.

A curious accident to an automobile occurred in New York a short time ago. The owner of the vehicle got out of the carriage first and turned to help his companion down, but as the latter stepped from the carriage her dress caught in the lever of the machine, turning it on at full speed. She jumped and reached the sidewalk safely, but the carriage went its way up the avenue with great speed. This trip, of course, was not a long one, as in two blocks it ran into a horse-drawn cab, which it demolished. The automobile itself was not injured.

Our American inventors and manufacturers of automobile parts and sundries are having well-deserved success abroad. We have already noted that the French patent for the auto-sparker has been sold to MM. Panhard and Levassor. Now we are pleased to state that the English rights have been sold to the Motor Manufacturing Company, the largest company manufacturing gasoline carriages in England, for a considerable lump sum and a royalty on each machine manufactured during the life of the patent. This fact is significant as showing the great future in store for products of this kind, and the necessity for adequate protection by foreign patents.

An important test of military automobiles is to be made in England. The Minister of War has recently announced a concourse of automobiles for which three prizes are to be given—$2,500, $1,500 and $500; the prizes are to be awarded by a special commission after a series of tests which will commence on the 4th of December. The following are some of the conditions laid down for the tests. The vehicle must be able to run upon bad roads and even across fields. The total load carried is to be 5 tons, of which the tractor carries 3 and the rear wagon 2. The platform surface is to be 15 square feet per ton. The tractor and wagon must be provided with movable side pieces 2 feet high. The platform of the tractor, when empty, must be at most 4 feet 3 inches from the ground, and that of the rear wagon 4 feet. The train when loaded with its 5 tons is to give the following results: 1. A speed on level grade of 8 miles an hour. 2. A mean speed of 5 miles an hour upon average roads with up and down grades. 3. Upon the road it should, while fully loaded and by its own aid, mount grades of 1 in 8. All the parts of the mechanism are to be protected against accidents, mud and dust. The controlling mechanism is to be strong and powerful. The train should give 48 hours' work without extra attention or repairs. The driving-wheels are to have a diameter of at least 4 feet 6 inches. There is no restriction as to the choice of the combustible or type of motor.

The tour of Scotland, which has been organized by the British Automobile Club on the occasion of the Glasgow Exposition, promises to be an interesting event. The tour of 500 miles will begin on the 2d of September, and last 5 days. Among the points to be considered in the test are the price of the vehicle, its weight, the capacity of the motor, the number of persons or the weight transported, the price per horse power, price per person transported, force in proportion to the weight, the extra power of the motor and the flexibility of the mechanism as shown in the mounting of grades, and the simplicity of the transmission devices. Among other points are the value of the steering devices and of the mechanical parts, the ignition of the motor, appearance of the vehicle, its condition after the trip, stops and accidents, etc. As will be seen, the programme is of a distinctly practical nature. Five different tours are to be made. On the first day, Glasgow-Edinburgh and return, or 116 miles. Second day, Glasgow-Ayr and back, 108 miles. Third day, Glasgow-Callander and back, 96.5 miles. Fourth day, Glasgow, Stirling, Glen Devon and return, or 95.5 miles. Fifth day, Glasgow-Clianlarich and back, or 116 miles. Each firm has the right to enter two vehicles of the same size and make; racing machines will be excluded, as this is exclusively a touring race. Another event is the tour of Ireland, which is organized for the 4th of August. A number of leading chauffeurs are engaged. The trip, starting from Dublin, will last 15 days, and the public will have an opportunity to inspect the machines upon their return to Dublin.

Present State of the Production of Steel Castings.*

ABSTRACT OF A PAPER BY A. TISSOT.

It is to its chemical composition, and especially to its small proportion of carbon and silicon relative to cast iron, that cast steel owes its qualities of resistance and tenacity, but it also owes to them other properties which are of a nature to work against the different operations of casting, such as the formation of the mold, the cast, the cooling, and the perfection of the surfaces. The fusing point of steel is very high and ranges from 1,450 degrees to 1,500 degrees C., so that the metal must be cast at a high temperature to give it sufficient fluidity. This temperature varies according to circumstances from 1,500 to 1,800 degrees, and may reach 2,000 degrees C. The sand of the mold must thus be highly refractory to support the flow of the metal at this high temperature without erosion; but it must also be plastic enough to keep its form before baking, these forms being often quite complicated. These two qualities, which are somewhat contradictory, could only be realized together by using complicated preparations or natural sands unfortunately rare. Owing to the high fusing point, the great shrinkage of the steel upon cooling has been a source of difficulties; this reaches as high as 1.5, 1.8, or even 2 per cent, and causes considerable tensions in the piece. If the mold offers great resistance to its free action the piece is likely to break while hot, or if it does not, it presents differences of molecular tension in different parts which cause it to break when cold upon a slight shock or cooling. Again, the solidification, attended with diminution of volume, tends to the formation of empty spaces in the mass. Blow-holes constitute another grave defect; the metal in solidifying retains its dissolved gases or those disengaged by the mold. The united efforts of the metallurgists and the founders have successively triumphed over these difficulties, either in suppressing them or avoiding their harmful effects. The quality of the sand was first considered by the founders. Natural sand has been found, sufficiently refractory and plastic, containing about 85 per cent of silica and 10 of alumina, but owing to the cost of transport, an artificial sand was looked for, and this has been made by mixing refractory material (quartz and analogous substances) with a plastic element, such as clay. After a great number of experiments a good composition was finally reached.

The great shrinkage of the metal presented the greatest difficulty in the molding process and has exercised the ingenuity of the founders. Among the precautions taken may be mentioned: Reinforcing ribs applied to a weak portion, cores of sand to be embraced by the metal and oppose its shrinkage, the taking of the metal out of the mould just after the casting, and while still red, or in recent cases, flowing the metal into the mold before baking, when the sand, owing to the action of the vapor formed, falls off like a friable earth a few moments after the steel is solid. Against the unequal cooling of the mass, the usual plan has been to add an auxiliary mass which feeds the weaker part and keeps it heated longer. Among the recent improvements in casting may be mentioned the molding machine; its use has been made possible by the side-blowing converters, which furnish steel at a very high temperature, and it may be taken out in quantities as low as 100 pounds in a sufficiently heated state; this separation of the metal in fusion permits its use in the mechanical molding process, and at present 1,200 to 2,000 pounds of small pieces, weighing from 10 to 40 pounds each, are cast per day with one machine. A new process known as "air tempering" has greatly improved the metal, due to the application of the theories of Tschernoff and of Osmond and Werth. It was found that a simple annealing of the metal was not sufficient. Tschernoff showed that by fixing the amorphous state of the grain at a point above the critical temperature of iron, the grain became fine and homogeneous. In practice this is carried out by heating the cast steel to 1,000 degrees C. and cooling it suddenly in air from 1,000 to 600 degrees; the resistance to shock is greatly increased, and favorable tests have been made with car-wheels, etc. The air-tempered metal is much more elastic and tenacious than ordinary annealed metal.

The progress made in the manufacture of steel must also be considered. The production of steel by the Martin furnace has been greatly improved in the last ten years, and its capacity, as well as the quality and purity of the steel, has increased. The metal formed by the acid process has lost its former hardness, and it may be obtained for casting with a resistance to traction of 35 tons per square inch, 25 per cent elongation and a resistance to shock of 20 strokes of a 40-pound plunger falling from 3 to 6 feet height upon 1.2 by 1.2 inch bars, with 6.4 inches between supports. The castings have become more tenacious and resistant, with less risk of cracking; they are free from blow-holes and are more homogeneous. A new application is that of the basic Martin process; owing to the use of aluminium, etc., the basic furnace has even taken the lead, and besides using a pig containing more phosphorus, and therefore cheaper, it gives softer products and is favored for pieces to resist bending strain or shock. To cite average results, basic steel for casting tests at 30 tons per square inch, with elongation of 25 to 28 per cent and a resistance to shock of 30 plunger strokes. In both the Martin steels the hardening elements, carbon, manganese, and silicon, have been reduced. An average analysis gives: Carbon, 0.25 to 0.50 per cent; manganese, 1.00 to 0.50 per cent; silicon, 0.20 to 0.45 per cent. Owing to the increased use of cast steel, Martin furnaces have been constructed of increased capacity, now reaching 50 tons. The side-blowing converter is another great improvement and is largely used; it gives a resistant and tenacious metal, which for casting is softer than that of the Martin furnace and is obtained in qualities ranging from 28 tons per square inch resistance and 35 per cent elongation to 56 tons and 7 to 8 per cent elongation. Its temperature is 200 to 300 degrees higher than that of the former steel. From apparatus of 1 or 2 tons capacity, castings of 4 or 5 tons have been made by accumulating two or three successive runs, and the heat of the metal keeps it sufficiently liquid to allow this; more recently apparatus of 5 or 6 tons capacity have given castings of 15 tons, and nothing will prevent casting up to 30 tons with a converter of 12 tons capacity. The extremely high temperature permits of making pieces 25 to 30 feet long, either in one piece or in several lengths united by the welding process characteristic of converter steel; this is accomplished by re-melting under the action of a jet of steel the parts nearest the joint and letting them cool slowly. This gives to the welded part a resistance equal to the rest of the piece. Among other steel producing processes may be mentioned the Walrand-Legenissel, the Thomas converters, etc.

The results of these improvements in steel casting are shown by its numerous applications in the different industries. The smaller industries, agriculture, construction of bicycles and automobiles, etc., have demanded thousands of small pieces of new pattern, which would have formerly been cast of iron or forged, and which the converter process especially has permitted to turn out under the best conditions. The heavy constructions, whose needs are so diverse, have multiplied the uses of cast steel. One of the late examples is the construction of the arches of the Alexander III. Bridge at Paris, and the rapidity and regularity with which the 2,500 tons of castings were executed shows the point of perfection to which the industry has arrived. Its use in mechanical construction is well known, and among other pieces may be mentioned cylinders of hydraulic presses, valves, collectors of multitubular boilers tested at high pressures under 0.4 to 0.8 inch thickness; shafts of cast steel which nearly equal forged steel; foundation plates for machines or engines, twice as light and twice as resistant as those of cast iron; gear wheels up to 12 and 15 feet diameter, etc., etc. In railroad work, it has almost completely replaced iron and rolled steel for frogs and crossings, and is used extensively in car construction; the use of cast steel wheels or tires is now becoming general; especially noteworthy is its extensive use in locomotive construction, and in this it will soon predominate. Naval artillery has taken advantage of the facility with which complicated forms can be secured with all the resistance of forged steel, and has simplified the gun-carriages while making them render the maximum effect with the minimum of weight; pieces have been made which would not have been thought of ten years ago. In naval construction cast steel has furnished, in all the variety, importance, and complication of form demanded by contemporary naval art, the numerous elements required. The heavy pieces contrast with the lightness of the helices, special cylinders, certain foundations cast in 0.3 inch thickness, and various light pieces used in the construction of torpedoes.

The great extension of electrical construction has found in cast steel a powerful aid and in turn has furnished it a new and important outlet. The extent to which steel castings are used in dynamo and motor work need not be dwelt upon. The converter process is specially advantageous here, and a steel very low in carbon, manganese, and silicon is produced, whose softness is advantageous for the magnetic circuit. At the exposition have been shown some remarkable samples of castings containing, carbon, 0.14 per cent; manganese, 0.34, and silicon, 0.06, and giving a resistance to traction of 24 tons per square inch, with 35 per cent elongation. The cast steel industry, although recent, has thus gained an important place, and it is not surprising that its annual production has increased from 30,000 tons in 1889 to more than 200,000 at present.

* Specially prepared by the Paris Correspondent of the SCIENTIFIC AMERICAN.

SIR NORMAN LOCKYER ON SUN SPOTS.

It is at once inspiring and overwhelming to converse with Sir Norman Lockyer upon his work in the domain of solar physics—overwhelming, because of the immensity of the subject; inspiring, because of the absolute certainty and entire confidence with which he explains his operations and points to the direction by which results may be hoped for. It will be remembered that Sir Norman has expressed the hope that in a few years' time meteorologists will be able as the result of observation of solar phenomena, to predict the time, and even, perhaps, the place, in India in which famine may be expected, and so enable the authorities to take precautions against loss of life, while they will also be able to give warning of high and low floods in Egypt. The vast importance of such a work as this is too obvious to need emphasis. Apart from the humane consideration as to health and happiness, its commercial significance would be enormous in ways which are apparent.

The amount of labor involved in completing the task to which he has set his hand is enormous and difficult beyond comprehension, but Sir Norman and his staff are working methodically along at the Solar Physics Observatory, at South Kensington, and have so far pieced up the threads of the solar skein as to justify a promise as to the ultimate success of the work. Sun spots and "prominences" are the mute prophets of ill-tidings from which the secrets are to be wrung. For more than a quarter of a century his attention has been devoted to the subject, and examination of all the data obtainable bearing upon droughts has given him a possible clue to the causes whose devastating effects we too frequently see in hunger-stricken India. Between the condition of sun spots and prominences, and plenitude of rain or its lack, a distinct connection is more than suggested. The subject is too technical and abstruse for effective treatment in the present article, but it may briefly be said that upon the variations of the spots and prominences, the meteorological condition of India and Egypt depends.

"I have shown," said Sir Norman, "that the famines which have devastated India during the last thirty or forty years have followed a definite law, and, of course, one therefore assumes that a similar thing may happen in the next thirty or forty years; having that law, we ought to be able, in some cases at all events, to observe that certain times are more apt to be associated with famines than other times."

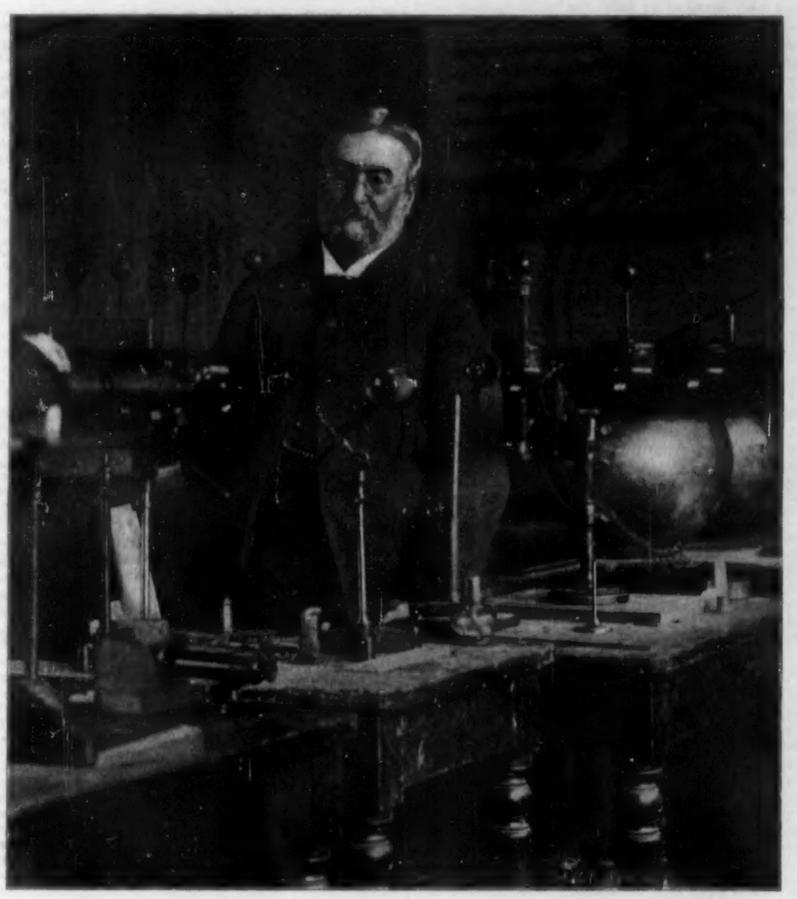
It has been argued that, inasmuch as the sun spots occupy, as to some of them, only an infinitesimal space on the surface of the sun, they are too minute to affect the meteorological results with which they are associated. But Sir Norman points out that the greater disturbance of certain zones of solar latitude is more influential than the amount of spotted area determined from spots in various latitudes. "Sun spots," he said, "may be only millionths of the area, but these prominences form one-sixth of the sun's visible hemisphere, and with these in a state of disturbance, the effects upon the earth are very important. The sun spots themselves are only a very feeble indication of the fierce activity of the sun.

"We are observing those prominences more carefully," he went on, "than we have been able to do in the past. We are taking advantage of new methods of observation, and in a few years we shall be in a much better position than we are now to study the connection of solar and terrestrial meteorology."

At present Sir Norman is concentrating his energies upon India. Asked if he had expectations of his discoveries being applied to other parts of the world, he answered: "No doubt, in the long run, we shall be able to study the weather in other regions, but it is hard enough work to get it out for one place at present."

Sir Norman fears that no profitable discoveries will eventuate fro.. the recent eclipse. Pressure of work at South K..nsington, coupled with a fore-knowledge that the ..reak-up of the monsoon would militate against ..ood results being obtained, prevented his absenting himself from his observatory during the four months which the expedition would have involved. The ill-luck with which the expeditions for the most part met he had feared would be encountered.

The sun spot observed lately he regards as of the greatest importance. "It shows us, beyond all question, I think," he informed the writer, "that the minimum is past. And that is a very important matter. It is very remarkable that a spot in the minimum period, apparently the first spot of a new cycle, should be of such magnitude. We are working at it, but cannot say anything definite for the moment. It will take some time before any certain pronouncement can be made, but it looks very much as if it will enable us to fix the period of the minimum, which before was uncertain to a year. If we can fix that, it will be very helpful for subsequent work."—For the photograph from which our engraving was made and the foregoing particulars we are indebted to our English contemporary, Black and White.



SIR NORMAN LOCKYER IN HIS LABORATORY AT SOUTH KENSINGTON.

Metal Niobium.

M. Henri Moissan has lately succeeded in preparing the metal niobium in a pure state by the aid of the electric furnace. Heretofore the properties of this metal have been practically unknown, and the metal itself has not been prepared in the pure state except by Roscoe, who obtained it as a gray powder. M. Moissan now produces a considerable quantity of the metal in the electric furnace, starting from an American niobite which contains niobic and tantalic acids. An alloy of niobium and tantalum is first obtained by reducing the powdered mineral with carbon in the electric furnace. This alloy is crystalline, of a light-gray color, and contains about 2 per cent of combined carbon. By a series of reactions the niobium is separated from the alloy in the form of niobic acid, which, after calcination, is a pure white powder. To prepare the niobium, the acid is mixed with powdered carbon and pressed into small cylinders; a number of these are placed in a carbon trough contained in a carbon tube, and the whole placed in the middle of the electric furnace. A few minutes' heating suffices, with a current of 600 amperes and 50 volts. The decomposition is violent, and as soon as the niobic acid becomes fused a lively effervescence takes place. After cooling, a well-formed ingot of metallic niobium is obtained, which contains from 2 to 3 per cent of combined carbon. The metal has been examined as to its physical and chemical properties. It is quite hard, and scratches glass and quartz easily. It is not fused in the oxy-hydrogen flame, and therefore its fusing-point is above 1,800 deg. C., but in the electric furnace it liquefies easily. As to its chemical properties, it is found to vary considerably from most of the other metals. It does not decompose water vapor at a red heat, and is almost unattacked by acids. Hydrochloric and nitric acids and aqua regia have no action upon it; hydrofluoric and sulphuric acids attack it but slightly, but it dissolves rapidly in a mixture of hydrofluoric and nitric acids. The gases attack it more readily. Heated in fluorine, it becomes incandescent and gives abundant fumes of a volatile fluoride. Chlorine attacks it at 205 deg. C., with disengagement of heat, producing a volatile chloride, $NbCl_5$, of a golden-yellow color. Bromine vapor forms a light-yellow sublimate, but iodine seems to be without action. The niobium, reduced to powder and heated in a current of oxygen, takes fire at 400 deg. with brilliant incandescence, forming niobic acid. When the powdered metal is heated in a current of nitrogen, to 1,200 deg., each particle becomes covered with a fine yellow coating of nitride of niobium. The action of carbon is somewhat curious. When the metal is maintained in fusion in the presence of graphite, it slowly absorbs carbon, which enters into combination. Niobium does not readily form alloys with the other metals. Sodium, potassium and magnesium may be distilled over it without combining, and it does not form an alloy with zinc. When heated with soft iron in fusion a small quantity enters into combination with the iron. The alloy shows an irregular structure containing fragments of niobium, a combination of the two metals, or perhaps a double carbide, and pure iron in excess. Oxide of chromium is reduced by the metal in the electric furnace, and gives a brittle alloy of chromium and niobium. Fused potash attacks the metal with the formation of an alkaline niobate. Chlorate of potash reacts upon it at a high temperature with brilliant incandescence, and nitrate of potash attacks it with violent disengagement of nitrous fumes. The reactions obtained with niobium seem to place it apart from the other metals and ally it to boron and silicon.

American Tin Plate Industry.

American manufacturers of tin plate are making rapid gains in their attempt to enter the foreign markets of the world. To be sure, their exports are yet small as compared with the domestic demand which they are meeting, but they are again reducing the imports, which temporarily increased in 1900 under the excessive demand and extremely high price of materials, and are at the same time increasing their exports in a manner which proves interesting to those who have watched the development of this comparatively new industry in the United States. The figures of the Treasury Bureau of Statistics show that the exports of tin plates from the United States, which in the ten months ending April, 1899, amounted to only 183,955 pounds, and in the ten months ending with April, 1900, to 275,990 pounds, were, in the ten months ending with April, 1901, 1,306,100 pounds. In imports of tin plates the figures for the ten months show a material decrease as compared with the quantity imported during the same period of the preceding fiscal year, being 98,609,722 pounds, as compared with 123,598,773 pounds for the ten months' period of last year.

Our total exportations of tin plate in the fiscal year 1901 seem likely to be from eight to ten times those of 1899, while the importations of tin plate into the United States promise to be little more than one-tenth those of 1891, the year of the largest importation of tin plate into the United States.

The Current Supplement.

The current SUPPLEMENT, No. 1337, has an interesting collection of articles. The first subject treated is "Objects and Methods of Investigating Certain Physical Properties of Soils," and deals with important forms of scientific apparatus. There are several chemical articles dealing with various subjects. "A Century of Civil Engineering" is by J. J. R. Croes. "Thais and Serapio" is an interesting archæological article. "The Suppression of Tuberculosis" is by Prof. Robert Koch, and his views tend to revolutionize our ideas regarding this dread disease. "American Locomotives in England.—I." is the first instalment of a series of articles which has been attracting great attention. "School Room Temperature and Humidity" is an address by W. G. Bruce.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

ELECTRICAL IGNITION APPARATUS.—ANSBERT E. VORREITER, Aix-la-Chappelle, Germany. The apparatus is an improvement on the igniters hitherto used by reason of its simplicity of construction and consequent certainty of action. The three principal parts of the inductor igniters hitherto used—coils, igniting-leads, and the actual igniter—are reduced to a single apparatus. Igniting-leads are dispensed with.

Engineering Improvements.

ENGINE.—EDWARD E. REDFIELD, Grants Pass, Ore. This invention relates to an engine to be driven by motive fluid of any kind. The engine is especially adapted to operate drag-saws, but can be utilized for other purposes as well. The novel features of the invention are to be found in a peculiar valve mechanism controlling the steam or other motive fluid employed.

INJECTOR.—CARL PRÜSMANN, Magdeburg, Germany. This invention provides an injector which is constructed to facilitate the starting action thereof. Such end is attained by providing a chamber having direct atmospheric communication, through which chamber the mixing nozzle extends. The mixing nozzle has two openings into this chamber. The steam escaping through the first opening and thence to the chamber and finally into the atmosphere, induces a sucking effort at the other opening, and thus the entire mixing nozzle is subject to a steady exhausting influence which tends to start the action of the injector. After the operation of the injector has been started the normal and usual operation is brought about by the closing action of a check valve arranged to command the atmospheric communication of the chamber referred to before.

ROTARY ENGINE.—GEORGE W. SMITH, Petersburg, Ill. A rotary engine patented by this inventor has the valves and ports so arranged that the engine has no dead center position, and the power exerted to turn the piston is uniformly distributed. Provision is also made to insure steam-tight packing and secure an easy motion to the cut-off valves that control the admission of steam to the cylinder.

Mechanical Devices.

BARREL-WASHING MACHINE.—CHARLES J. DOBLER, Manhattan, New York city. In this machine but a single tank is employed, the machine being so constructed that the barrels or kegs can be soaked and partially filled in the tank and subsequently cleaned within and without. Water is made to circulate through the tank. Means are provided for heating the water. The kegs are received by a table and delivered, partially filled, to an agitating or scrubbing mechanism for the exterior, from which mechanism they are delivered to supports. From these supports the kegs may be conveniently removed and placed upon adjacent sprinklers forming a portion of the machine.

AUXILIARY SPACING DEVICE FOR TYPEWRITERS.—GAY P. BLESSING, New Milford, Pa. By means of this device the direction of the carriage of a typewriter can be reversed at any time to the extent of one or more points, whereby the operator is enabled to correct a misspelled word or a letter erroneously struck. The device may be applied to any standard typewriting machine, and when not in actual operation will not interfere with the usual movement of the carriage.

LOCK.—OSCAR KATZENBERGER, San Antonio, Tex. The inventor has devised a combination-lock in which independent knobs, controlling the combinations, are located at the outside of the lock or outside of the door. These knobs are adapted to permit or to prevent the movement of the bolt. Numbers or characters need not be produced around the knobs or the plates through which they pass; the numbers of the combination and their arrangement are determined by sound or touch. The bolt may move independently of the knob by means located at the inner face of the door. Hence the door can be instantly opened from the inside even if the bolt is in locking position, and held in this position by the knobs.

STONE-CARRIER.—WILLIAM H. DEMOREST, JR., Manhattan, New York city. The machine is a stone-carrier for stone grinding and polishing machines, on which carrier the stones are held and moved back and forth over the cutting tool. The carrier has a vertically adjustable beams on which, adjustable longitudinally, jaws are mounted. A rod extends between the jaws, and nuts work on the rod and engage the jaw. By means of the rod the jaws may be moved together and held engaged with the stone.

SPOKE-FINISHING MACHINE.—GEORGE A. ENSIGN, Defiance, O. To the long list of machines invented by Mr. Ensign for the Defiance Machine Works must be added an ingenious spoke-finishing machine, by means of which spokes are accurately and uniformly finished both at the throat and face without the employment of skilled labor. Among the novel features of the invention may be mentioned an intermittently revoluble spoke-holder provided with revoluble spoke-sockets for holding the revolving spokes. A sand-band engages and finishes one of the spokes, and a revoluble sand-wheel finishes the face of another of the spokes. It is the duty of the operator merely to remove the finished spokes and place unfinished spokes in position, and at regular intervals to unlock the spoke-holder.

PAPER-STAPLER.—DANTON O. BRUNNER, Somerset, O. The invention provides a hand-operated machine for driving staples through two or more sheets of material. The device is so constructed that a number of staples can be placed in a suitable chamber and automatically fed, one after the other, to a plunger. By means of the plunger the staples are driven into the material and are clenched upon a table forming a part of the device. The mechanism is operated by handles.

PRINTING MECHANISM FOR LABELS OR TICKETS.—JOSEPH LEAVY, New Brighton, and ISAAC ROGGEN, Manhattan, New York city. By means of this machine the individual tickets and labels of a strip are automatically held one after the other in position to be printed upon. After the impression has been made the labels or tickets are fed forward. Suitable operating mechanism is provided to withdraw the tickets just before their forward feed. The inking-roller is concentrically mounted on a stationary support. The printing-head is mounted eccentrically on a shaft which also carries a feed-cam. This cam acts upon the labels or tickets just before the act of impression, holding the label stationary, and further acts to feed the printed label forward or from the printing-head after the impression has been made. The printing-head is mounted eccentrically and the printing-roller concentrically to prevent any portion of the printing-head from touching the inking-roller, except that surface which is farthest from the axis of the head.

CURRENT MOTOR.—ROBERT S. THEALL, Fort Pierre, So. Dak. The inventor has devised a simple and ingenious motor for utilizing the power of a flowing stream, ocean tides, and the like. Mechanically considered, the invention comprises a float having at one edge a post on which a mast is mounted to turn. Over the float and water a series of sweeps or rotating arms extend from the mast. Levers are pivoted upon the sweeps and carry buckets or vanes which drop into the water, the levers extending above the sweeps to engage the mast-stays as stops. The upper ends of the levers have boxes which receive counter-balance weights whereby the vanes may be balanced or permanently raised. An incline extends downward from the float into the water and engages the vanes to raise them out of the water. The device is simple in construction and efficient in its operation.

TENSION FOR BRAIDING-CARRIERS.—JULIUS A. TURNER, Southfield, Mass. The invention provides a simple tension for the racers of braiding-machines, particularly whip-lash-braiding machines, comprising a fixed guide-block, a pivoted pressure-block, and a convenient means for moving the pressure-block and regulating the pressure against the thread or strand.

SIFTING-SCREEN.—ALBERT E. THORNTON, Atlanta, Ga. The sifting-screen is to be used primarily as a separator to take the meal from the ground-up cotton seed immediately after leaving the huller. The machine is designed to secure a better adjustability of the screens of a larger amount of shaker surface in proportion to the floor space occupied and to facilitate the substitution of different sizes of screens.

DAMPENING-MACHINE.—HERMAN WEBER, Lincoln, Neb. The machine is to be used for dampening clothes in laundries before ironing. Aprons are used which move through water-pans and become saturated with water. The clothes are placed upon the upper stretch of the lower endless apron and are carried along between wringer-rollers, which squeeze the moisture from the apron and distribute it evenly upon the clothes.

Vehicle Accessories.

SIDE APRON FOR VEHICLES.—THOMAS H. JOYCE, Brooklyn, New York city. This new and improved side apron for vehicles is arranged to permit convenient egress from the vehicle body and to protect the occupants from side drafts, rain or snow, and at the same time allow independent use of the lap robe and free handling of the reins.

Railway Appliances.

CAR-FENDER.—FRANK WARGA and L. P. PLATT, Hastings, Pa. In a car fender patented by these inventors a truck is provided beneath the fender, the wheels of the truck running on the car track, and in front of the truck a diagonally disposed horizontal cushion roller is mounted. To guard against the rising of the fender and its cushion roller a device is arranged on the dash-board of the car which can be pressed down against the fender and maintain the latter close to the track so that when the fender strikes a person the latter cannot be forced beneath the fender.

CAR-COUPLING.—WATSON S. LENNON, Tucson, Ariz. The invention relates to a class of couplings having a laterally swinging jaw or knuckle adapted to couple with a like knuckle on another car and by manual adjustment to be released therefrom. The object of this invention is to provide novel simple details of construction for a car-coupler of this kind, which adapts the coupler for very efficient service and avoids the danger of breakage of the drawhead.

Miscellaneous Inventions.

LOOM TEMPLE-ROLL.—FRANK O. DUFFY, New Bedford, Mass. As almost all kinds of cloth tend to shrink while the weft is being beaten in by the reed, it is almost impossible to keep the cloth sufficiently extended without danger of tearing or marking it up. This is especially the case with temple-rolls having teeth projecting from the peripheral surface of the solid body. With such temple-rolls only a few of the innermost teeth really hold the cloth, and in case of a heavy lateral strain the cloth is torn or injured. Mr. Duffy overcomes these difficulties by constructing the roll so that it will yield laterally in proportion to and in the direction of the strain, and with an equal strain on all the projecting teeth engaging the cloth.

CENTER-LINE LEVEL.—BARTLETT B. CHANDLER, JR., Nevada City, Cal. The center-line level comprises a glass tube closed at its ends and filled with liquid. The tube is cast to form a central passage for the line. A level thus constructed can be readily slid along the line. The bulb can always be seen at the top should the tube be rotated, since glass is the material used.

MANUFACTURE OF ETCHED METAL RULES.—JOHN CAMPBELL, Matteawan, N. Y. It has heretofore been the practice to use separate transfer strips for the several sides of the ruled blank; and as the final graduations to be produced on the sides of the rule required accurate register it was necessary to exercise considerable skill to place the transfer-strips in proper position on the blank to insure the registering of the graduations on the several sides. The inventor overcomes these objections by preparing a single transfer strip with the graduation marks in perfect alinement with each other, so that the graduation marks, when transferred upon the metal blank, must necessarily register.

GAS-VENTILATOR FOR MAINS.—MILTON C. HENLEY, Manhattan, New York city. It is the purpose of this invention to provide a device whereby the gases which escape from defective mains are prevented from entering cellar and basement doors. The device which Mr. Henley has invented fully meets all requirements. His ventilator comprises a casing designed to be seated in the ground and having a grating top extending above the ground. Open pipes lead from opposite sides of the casing within the ground. Open ended branch-pipes extend from the opposite sides from the first-named pipe. The escaping gas finds its way into the open ends of the several pipes and then passes into a suitable casing. Thus the device acts as a barrier to prevent the discharge of gas into a house or cellar.

SMOKE-PREVENTING ATTACHMENT FOR LAMP-BURNERS.—EDWARD L. GORISCH, Jersey City, N. J. The purpose of this invention is to provide an attachment for lamp-burners so constructed that the flame will be of full volume and smokeless. The wick can be quickly and evenly cleaned without the use of scissors. The device is attachable to any lamp-burner or oil-stove.

SAW-TOOTH GAGE.—WILLIAM MCKNIGHT, Ebensburg, Pa. The invention is an improvement in circular saw-tooth gages, and provides a simple device designed to be engaged with the saw-teeth, whereby the teeth may be filed perfectly square or flat on the back, front and point, and whereby the length of the teeth may be equalized and the saw kept round.

Designs.

MANTLE-HOLDER.—RALPH COHEN, Bayonne, N. J. The holder has a segmental body and an axial or transverse member extending inwardly from a terminal of the body and terminating in a hook wherefrom the mantle is suspended.

BADGE.—LENA BENNETT, Manhattan, New York city. The leading feature of the design consists of a buffalo rampant holding a pan with the dexter foot. The purpose of the design is to provide a Pan-American Exposition souvenir.

CANDY-MOLD SECTION.—BENJAMIN F. DEKLYN, Manhattan, New York city. The candy-mold section has an elongated concave body of the general outline of a peanut and has a number of raised portions of irregular outline to produce the pitted portions of the peanut shell.

PICTURE-HANGER.—JOHN A. CHRISTMANN, Mount Pulaski, Ill. The picture-hanger consists of a flat plate, from the front face of which a series of buttons project. A loop extends from the front face, next to the last button. By means of this plate a picture can be hung at any desired height.

BOTTLE.—JOHN SCHIES, Anderson, Ind. The bottle body is formed with a series of chambers or protuberances which extend longitudinally in the direction of length of the bottle and are rounded at their upper ends, the adjacent protuberances being connected by curved portions in such manner that the bottle presents in cross section an appearance simulating that of the shamrock.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

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Inquiry No. 1172.—For marine engine of 150 to 200 horse power, with minimum of weight, for shallow waters.

Inquiry No. 1173.—For time registers suitable for keeping time of the help employed in a small factory.

Inquiry No. 1174.—For manufacturers or dealers in the lens used in search lights, head lights, etc. to converge rays of light.

Inquiry No. 1175.—For parties to manufacture aluminium or pasteboard novelties.

Inquiry No. 1176.—For manufacturers of machines for making up change for pay rolls.

Inquiry No. 1177.—For manufacturers of ax-handle machinery.

Inquiry No. 1178.—For spoke machinery.

Inquiry No. 1179.—For cant hook machinery.

Inquiry No. 1180.—For manufacturers of a packing that will stand in hot and cold water.

Inquiry No. 1181.—For manufacturers of useful and attractive novelties.

Inquiry No. 1182.—For the manufacturer of the Eureka egg keeper.

Inquiry No. 1183.—For manufacturers of bakery machinery.

Inquiry No. 1184.—For manufacturers of tinsmiths' maceinery.

Inquiry No. 1185.—For manufacturers of hand and treadle power woodworking machinery.

Inquiry No. 1186.—For manufacturers of small ironworking machines.

Inquiry No. 1187.—For manufacturers of angle hoops for ends of steel water tanks 4, 5, 6, 7, and 8 feet in diameter.

Inquiry No. 1188.—For manufacturers of machines for hollow grinding razors.

Inquiry No. 1189.—For an ice-making machine for home use.

Inquiry No. 1190.—For manufacturers of planer and paper knives.

Inquiry No. 1191.—For manufacturers of steel laid stocks for shoe dies.

Inquiry No. 1192.—For manufacturers of grind stones.

Inquiry No. 1193.—For a newly patented shooting gallery with moving animals.

Inquiry No. 1194.—For manufacturers of gold lacquer for tin boxes.

Inquiry No. 1195.—For manufacturers of tooth-pick machinery.

Inquiry No. 1196.—For manufacturers, in Canada or the United States, of walnut and mahogany veneers, etc.

Inquiry No. 1197.—For manufacturers of farm fencing and fencing devices.

Inquiry No. 1198.—For manufacturers of glass blowers' supplies.

Inquiry No. 1199.—For parties engaged in the manufacture of pipe coils and pipe bending.

Inquiry No. 1200.—For dealers in hardware for trunks, suit cases, etc.

Inquiry No. 1201.—For dealers in the Victor self-buttoning collar button (patented).

Inquiry No. 1202.—For dealers in the Victor collar hook and tie holder (patented).

Inquiry No. 1203.—For the address of the manufacturer of the "Little Gem Savings Bank."

Inquiry No. 1204.—For manufacturers of papier maché candy boxes.

Inquiry No. 1205.—For the manufacturer of Walter Stouger's new battery.

Inquiry No. 1206.—For manufacturers of yeast cake machinery.

Inquiry No. 1207.—For manufacturers of transparent celluloid.

Inquiry No. 1208.—For manufacturers of sponge rubber in sheets, or shapes to order.

Inquiry No. 1209.—For manufacturers of water filters suitable for private use.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publ cation.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8314) R. V. asks: 1. If you know the voltage and amperage of a battery how do you find the watt output? A. Multiply the volts by the amperes. 2. Are the field and armature of a motor common or magnet wire? Could magnet wire be used? Should the primaries and secondaries of an induction coil be common or magnet wire? Could magnet wire be used? A. Magnet wire is used. Magnet wire is simply ordinary copper wire covered with one or two layers of cotton thread so that the wire of one turn or layer shall not touch the wire of the adjacent turns or layers. In other words, magnet wire is insulated wire; common wire is uninsulated. Insulated wire is used so that the electricity must go through the whole length of the coil round and round, and not pass across to the other end of the coil directly.

(8315) G. H. DeL.: I wish to kill a number of pole-cats by means of electricity, without damaging the fur. I have a 1,000 watt alternating current dynamo with 8-pole field and 8-pole armature, but do not have any idea of its practical value for this purpose. The floor upon which the animals are driven is finished off with strips of zinc 4 inches wide and about ½ inch apart, being properly insulated from each other, each alternating strip being connected for positive and negative poles. If this dynamo could be re-wound to do the work effectively, what would be your idea as to field and armature winding, also speed required, and what would be the minimum current required to produce the desired result? A. It is not probable that a high voltage is required to kill a skunk. The dynamo may be all right for this work as it is. We think the zincs should be wet with an alkali solution, caustic soda or potash, before the animals are driven upon them. This will insure good contact between their feet and the zincs. Then turn the current on by a switch and observe the result. We have no idea whatever as to the current required.

(8316) E. D. S. writes: In your issue of July 6, on page 12, "Notes and Queries," No. 8250, W. M. R. says he put a slotted core armature in the 8-light dynamo, and succeeded in getting 50 volts at a speed of 1,660 per minute as against 2,200 for the armature as usually constructed. To an amateur like myself it is interesting to note the difference in speed due to the improved magnetic circuit, and thinking there may be others interested in this dynamo I would describe a change I made in the magnets of this machine with very good results. The armature was made exactly to size, and the iron wire core was used. The field was the inverted horseshoe type with circular cores 6½ inches long, 4 inches in diameter, with quite stout pole-pieces and yoke, and of soft cast iron. The fields were shunt wound and took ⅝ of an ampere at 55 volts. The machine ran cool and sparkless at full load, and with volts at 55 our speed was 1,250 per minute, or nearly 1,000 slower than the speed for the other magnets. A. The change in the machine described by our correspondent makes a very different machine from the original machine. His circular core 4 inches in diameter contains over 12.5 square inches of iron, while the core in the original design contained about 8 inches of iron. Of course the voltage is greatly raised by the change, or, in other words, the original voltage can be produced by about two-thirds the speed. If he ran his machine up to full speed he would have between 80 and 100 volts.

(8317) C. J. M. asks: 1. Can you tell me where a spring motor can be got, one that would run a fan? A. Correspond with any of our advertisers who supply fans and motors. 2. Are boots or shoes made out of India rubber? I mean the soft pliable sheet rubber like that used for patching bicycle tires. A. Rubber overshoes were first made of the pure gum. This was fifty or more years ago, before the art of vulcanizing the rubber was invented by Goodyear. They have been made within a few years again, but the public did not want them and they were not a success. They bind the feet too closely and stretch too easily; they are not durable. The kind ordinarily used are much better in every way. 3. What causes the green stuff that forms in a creek or any slow-running water. It will form on a board or stone or anything water runs on, and what do you call it? I have seen it forming on a roof where condensed steam runs down. A. The green slime is a plant, or rather millions of plants, which grow from other plants just as higher plants do; only the method of their reproduction is entirely unlike that of the higher plants. The germ of the plant must have been taken to the roof by the wind or in some other manner and there have grown in the warm water condensed from the steam.

(8318) W. J. B. asks: Suppose a hole through the earth and its center of gravitation. Eliminating all friction and resistance to the passage of a ball dropped into this hole, the only force acting being that of gravitation, will the ball pass beyond the center of gravitation? In what manner will it come to rest, if at all? A. The ball will fall with an increasing velocity till it reaches the center of the earth. At that point it will have its greatest velocity and momentum. It cannot stop there. It will pass beyond the center of the earth as far as it has fallen to reach it; that is, it will go through the earth to the other side and then fall back to its place of starting. This it will continue to do forever under the conditions imposed. The motion is no different from that of the pendulum of a clock, which oscillates under gravity alone as readily as any other falling body. A pendulum is a falling body, exactly like the supposed ball dropped into the earth. It falls to its lowest position and rises as far beyond it as it has fallen, just like the ball dropped into the earth. The mechanism of the clock is simply designed to restore to the pendulum the energy which it loses in each swing because of the friction of the air and other frictions in its motion. These the freely falling ball is by the conditions of the question, freed from. Hence it will move forever without loss of energy.

(8319) H. G. M. asks: 1. Would like to know a simple method of securing copper plates to carbon (solid), e. g. A. Electroplate the carbons with copper, and then solder the copper plates to the electroplating. A firm connection will be made. 2. How are copper connections secured to carbon brushes? A. The carbon brushes are covered with copper by electroplating and the contact is made by a set screw pressing a plate of copper against the carbon brush. 3. Can this be done by any other than an electrolytic process? A. Not satisfactorily.

(8320) J. W. A. proposes these problems: 1. A contracts to furnish B electric motive power 11 hours per day, 26 days per month, at $2 per month per horse power, to be measured by a Thompson recording meter, sold by General Electric Company, giving readings on five dials in watt-hours. (The meter readings to be multiplied by a constant 4.) B installs a 10 horse power electric motor. Kindly take an imaginary reading and show the method of ascertaining the number of horse power to be charged for at end of first month. A. Eleven hours per day for 26 days are 286 hours. One horse power hour is 746 watt-hours, since 746 watts are 1 electrical horse power. To reduce a reading of the watt-meter in watt-hours to horse power per month: Multiply the meter reading by the constant 4 and divide by 746. The quotient is horse power hours. Divide this quotient by 286 and you have the horse power per month. 2. Please say which price is more advantageous to A (the seller of power), $2 per month per horse power or 2 cents per 1,000 watts. A. Two cents per 1,000 watts is a higher price than $2 per month per horse power based upon 11 hours per day for 26 days.

(8321) F. K. S. asks: 1. On the use of storage cells what is meant by sulphating, buckling and internal short circuiting? A. Sulphating is the formation of sulphate of lead by the action of sulphuric acid upon the lead of the plates. This wastes the active material. Buckling is the bending of the plates by the charging and discharging, and is due to the fact that the material occupies a different amount of space in its different forms as oxide or peroxide of lead. The buckling sometimes bends the plates to such an extent that the positive and negative plates touch each other and produce a short circuit, through which the electric current can pass without going through the external line. You should have a book on the storage cell, such as Salomon's Accumulators, price $1.50 by mail. 2. Is it necessary to use a voltmeter, ammeter and polarity indicator? A. Yes, to observe the condition of the battery and to know when recharging is necessary, or when the cells are fully charged. 3. Is it advisable with regard to the running expenses to use them? A. Yes, if you have a good and cheap current for recharging. 4. About what would be the cost of charging a 15 ampere hour battery of 6 cells? A. That depends upon the answer to the last question. 5. Which make would you advise me to get. Can you tell me anything of a volt ammeter? A. There is no advertising done in this column. There are reliable dealers who can advise you regarding their goods. The firm you mention deals mostly with schools and this class of trade requires good goods. 6. Is it necessary to use the cells immediately after charging, and to charge immediately after discharging, and can they be used on an open circuit, i. e., once in a while, or are they to be used on a closed circuit until discharged. A. No. They can stand on open circuit for a time. But sulphating takes place when standing.

(8322) H. C. S. asks: 1. Wishing to construct an experimental wireless telegraph outfit, if possible, I would like to know what is the shortest length of spark that could be used to illustrate the principle, having your instruments the length of an ordinary room apart? Also if you have published a SUPPLEMENT or can recommend a book containing a description of such an instrument? A. A coil giving quarter-inch spark will send a message much farther than the length of a room. A coil which will fill the requirements is described in SUPPLEMENT No. 160, price ten cents. There is no description of the apparatus for wireless telegraphy which gives dimensions and drawings to scale so that one could make it from the plans. Of course, there are reasons for this. These inventions are new and those who have developed the instruments have patented them and are not anxious to have others work in the same line. We have published descriptions of coherers and coils, etc., of the various parts, from time to time, such that one who had mechanical skill could make these parts from the descriptions and pictures without scale drawings and dimensions. We can send you SUPPLEMENTS Nos. 1318, 1319, 1320, price ten cents each. These contain a series of articles on "Electric Waves," in which a good description of a coherer is given, as well as many hints for making the various parts of an outfit. Fahie's "History of Wireless Telegraphy," price $2 by mail, is valuable. 2. Have you a SUPPLEMENT or do you know of a book showing the construction of a liquid air machine for amateurs? A. Sloane's "Liquid Air," price $2.50. We must say that the making of a liquid air apparatus is hardly a task for an amateur. 3. Name books or SUPPLEMENTS for constructing a voltmeter from 0 to 120 and an ammeter from 0 to 15. A. SUPPLEMENT No. 1215, price ten cents, contains exactly what you request.

(8323) W. E. S. asks: 1. Will a dynamo furnish the same spark for igniting a gasolene engine when the circuit is broken as the batteries will? A. Yes. 2. Can a dynamo be used in starting the engine without batteries? A. No, unless you have other power for running the dynamo than that of the gas engine. 3. Can a dynamo be used for igniting the engine and for lighting purposes also? A. A dynamo for igniting a charge in a gas engine is usually a small machine built for this special work. It is not adapted for lighting purposes. Current from a lighting plant could be used to ignite the gas for a gas engine.

NEW BOOKS, ETC.

LABORATORY INSTRUCTIONS IN GENERAL CHEMISTRY. Arranged by Ernest A. Congdon, Ph.D., F.C.S. Philadelphia: P. Blakiston's Son & Co. 1901. Pp. 110. Price $1.

The present work is intended to illustrate a course of study in general chemistry. Much of the material is original, having been developed in the course of ten years' experience in laboratory teaching, while those portions taken from other sources have been modified and added to so that they might better meet the wants of students. The book is interleaved.

LES INDUSTRIES CÉRAMIQUES. E. S. Auscher et Ch. Quillard. Encyclopedie Industrielle. Paris: J. B. Baillière & Fils. 1901. 16mo. Pp. 280. Price $1.25.

The authors have produced a book which deserves to take its place in the literature of ceramic industries. They have given formulas which have been tested by long experience, and have reduced the number of these formulas as far as possible in order that the work might not become too complex. The illustrations in the book, although not very excellent examples of engraving, are nevertheless clear enough for the purpose of the technical reader.

DAS GASGLÜHLICHT. Die Fabrikation der Glühneke ("Strümpfe"). Von Prof. Dr. I. Castellani, Autroisirte Uebersetzung und Bearbeitung von Dr. M. L. Baczewski. Wien: A. Hartleben's Verlag. 1901. Pp. 121.

It has been the author's purpose to give a fairly complete account of the manufacture of the well-known incandescent gas light mantles. He has, therefore, carefully and clearly described each step in the process of making the mantles, the properties of the materials which enter into that process and the source of supply whence these materials can be obtained. The work is the result of the author's long experience in the making of mantles.

INDEX OF INVENTIONS

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August 6, 1901,

AND EACH BEARING THAT DATE.

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Air regenerating and purifying apparatus, Desgrez & Balthazard	680,028
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Garment, A. Phillips........ 679,778
Garment fastener, N. Stutson........ 679,793
Garment hanger, R. Norris........ 680,168
Gas apparatus, acetylene, J. J. Hendler.... 679,964
Gas generator, acetylene, M. D. Compton... 679,726
Gas generator, acetylene, McNamara & O'Reilly........ 679,774
Gas generator, acetylene, T. B. Rider........ 679,862
Gas generator, acetylene, E. S. Martindale. 680,161
Gas generators, etc., governor for, T. H. J. Lackband........ 679,851
Gas holder, A. Davis........ 680,199
Gas producer, A. B. Calder........ 679,885
Gas purifying apparatus, A. L. Lion........ 679,761
Gate, E. W. Pratt........ 679,990
Gate, J. L. Maniota........ 680,054
Go cart, H. Levi........ 680,049
Gold separator or washer, G. Robertson..... 680,176
Governing mechanism for internal combustion engines, C. H. Blomstrom........ 680,116
Governor, E. P. Coleman........ 680,108
Grain, machine for handling, W. Galbreath. 679,737
Grinding mill, C. W. Pank........ 679,775
Grinding rolls, composite, W. E. Arnold... 679,821
Guns, apparatus for discharging ships', L. Obry........ 680,066
Guns, mechanical primer for, G. Stuart..... 679,792
Hammock support, T. S. Hayward........ 679,963
Harrow, J. W. Miller........ 679,854
Harvester, broom corn, M. Ingels........ 679,753
Hat block and gage, E. G. Taylor........ 680,063
Hay fork carrier, Patten & Hangen........ 679,986
Hay rack for wagons, R. E. Poindexter.... 680,070
Hook, P. B. Southworth........ 680,005
Hose nozzle, C. N. Edgell........ 679,733
Hose supporting device, M. B. Hammond... 679,893
Hub, ball bearing, P. F. Schaffer........ 679,995
Ice making apparatus, B. J. Ullrich. 680,087, 680,088
Incubator, J. L. Macy........ 679,764
Insect exterminator, J. K. Jessup........ 679,848
Ironing board and clothes rack, combined, G. B. Freeman........ 680,202
Ironing machine, W. M. Barnes........ 679,718
Irrigating ditch clay trough, V. von Holdt. 679,965
Jar or bottle closure, Madigan & Crocker... 680,053
Jar top, W. P. Coldren........ 680,125
Key keeper, A. B. Lang........ 679,758
Kiln, F. Alsip........ 679,817
Kiln, F. W. Heidenreich........ 679,842
Kiln furnace, F. Alsip........ 679,819
Kneading board, L. D. Patten........ 679,987
Ladder hook, E. L. Clark........ 679,887
Ladle car, Ferry & Laing........ 680,139
Lamp cord adjuster, electric, G. Webster.. 679,930
Lamp, electric arc, H. Bremer........ 679,878
Lamp, electric arc, H. Stens........ 680,082
Lamplighter, time, W. & F. Walter........ 680,090
Lamp shade, O. A. Mygatt........ 679,770
Lamp shade or globe, O. A. Mygatt........ 679,771
Lamp support, miner's, S. Davis........ 680,133
Lamps, manufacture of filaments for incandescent electric, W. L. Voelker.. 679,803, 679,926
Lampblack, making, G. Wegelin........ 680,003
Lathe, engine, C. W. Nitterauer........ 680,167
Lead by electrolysis, refining, A. G. Betts.. 679,824
Leather, article provided with head of, C. E. Bailey........ 679,823
Ledger, account, P. K. Paulsen........ 680,173
Letter box, A. M. Keeney........ 680,157
Lever, H. A. Backus........ 679,873
Life preserver, H. C. Bristol........ 679,721
Lifting jack, L. F. Brown........ 679,827
Loading or unloading apparatus, G. H. Hulett........ 679,967
Locomotive, G. W. West........ 679,808
Locomotives, strainer cleaning device for, R. K. West........ 680,096
Loom and filling carrier therefor, R. Burgess........ 679,941
Loom, bag, G. F. Hutchins........ 679,895
Loom filling replenishing mechanism, J. Northrop........ 680,169
Loom reed motion, E. H. Ryon........ 679,863
Loom shedding mechanism, H. Staubli...... 680,181
Lubricant for commutators, W. M. Jones... 680,155
Lumber coupling, J. B. Dubray........ 680,029
Machines upon ends of studs or shafts, means for holding loose members of, B. Holland........ 679,843
Mail bag holder, A. M. Harriott........ 680,041
Malt liquor, producing non alcoholic, W. Rath........ 680,076
Mantle support, N. E. Ericson........ 680,031
Match box shuck machine, C. B. Andrews.. 680,012
Mattress making machine, C. W. White.... 679,809
Measuring instrument, electrical hot wire, P. Meyer et al........ 679,769
Measuring tool, J. H. Armstead........ 679,820
Meat cutter, M. Burton........ 679,884
Medicinal agents, apparatus for vaporizing, E. T. Camp........ 680,122
Mercerizing apparatus, Crompton & Horrocks 680,131
Metals from their fused compounds, electrolytic process of obtaining, G. P. Scholl... 679,997
Micrometer, F. H. Pierpont........ 679,779
Miter box, A. L. Chandler........ 680,021

Mold for making chilled rolls, F. Gorman... 679,743
Motor, J. E. Blake........ 679,896
Motor, K. Gore........ 680,038
Motor, A. H. Hoadley........ 680,204
Mouthpiece, A. Bergman........ 680,113
Mower, G. H. Perkins........ 679,989
Nailing machine, J. H. Southcott........ 679,868
Necktie, C. H. Lowe........ 679,763
Nipper, police, G. A. Harrisson........ 679,841
Nut lock, G. Behler........ 679,935
Nut lock, Wingfield & Little........ 680,101
Nut lock, Braley & O'Neill........ 680,118
Oiling device, fountain, G. Burkhardt...... 680,193
Operating table, T. M. Vaughan........ 679,802
Ore concentrator, A. H. Stebbins........ 679,869
Ore desulfurizing apparatus, Oviatt & Dean. 680,171
Paper box, T. Schmidt........ 679,917
Paper box, folding, F. N. Young........ 680,105
Paper box, nestable, J. R. Van Wormer.... 680,186
Paper fastener, F. E. De Long........ 680,026
Pen, fountain, W. W. Stewart........ 679,790
Pen, fountain, C. W. Boman........ 680,117
Pencil sharpener, E. Burke........ 679,942
Phonographs, etc., platform motor for, W. H. Miller........ 680,060
Photographic printing apparatus, G. Gerlach 679,740
Pianos, bridge bearing for, F. Schimmel.... 679,916
Pinion housing, J. Kennedy........ 679,971
Plane, E. S. Marks........ 680,055, 680,056
Planter, J. M. Coleman........ 679,888
Plaster or bandage, adjustable adhesive supporting, Ross & Taggart........ 679,993
Plates or blanks of varying widths, forming, J. Lans........ 679,759
Pocket, garment, J. W. Shields........ 679,866
Pot handle, auxiliary, E. Meyer........ 680,058
Preserving fruits and their juices, means for, F. Butcher........ 679,943
Press for leather cutting, etc., A. G. Brewer 680,189
Printing press, J. L. Cox........ 680,128
Protractor attachment for center finding instruments, R. W. Bailey........ 679,934
Pump, L. E. Generelly........ 679,892
Pump, Whittaker & Turner........ 680,098
Pump, air or gas exhausting, Toupikof & Graham........ 680,184
Pumping engine, steam, J. B. Poore........ 679,859
Puzzle, G. L. Reenstierna........ 679,782
Radiator, A. Stadel........ 679,920
Rail joint, E. A. Mitzner........ 679,902
Rail joint, W. J. Devers........ 679,956
Rail joint, G. Condiff........ 680,023
Railway bed, J. R. Smith........ 679,867
Railway crossing, Ball & Gibson........ 679,874
Railway rail joint, B. B. Charlton. 680,195, 680,197
Railway rail joint plate, B. B. Charlton... 680,196
Railway switch, Cantrell & Empey........ 679,886
Railway track, H. E. Jackson........ 680,153
Ratchet wrench, E. C. Webster........ 679,929
Record sheet, W. D. Hawley........ 680,145
Reel line guide, H. Krueger........ 679,850
Refrigerator, J. R. Simms........ 680,004
Refrigerator car, J. Hommel........ 679,966
Register, P. S. Stauffer........ 679,789
Rein holder, C. A. Conger........ 679,951
Revolving chair, J. Ellenbecker........ 679,958
Rewinding and inserting mechanism, H. F. Bechman........ 680,111
Rifle, boy's drill, A. B. Mellis........ 679,768
Rock, treating metal bearing, T. J. Lovett. 679,901
Rocking chair, C. L. Santee........ 679,864
Rolling mill, R. H. Snyder........ 679,919
Roofing seamer, W. C. Bell........ 679,719
Rotary engine, H. A. Benson...... 679,936, 679,937
Rotary engine, F. S. Pickering........ 680,068
Roving, spinning, or analogous machine, T. A. Boyd........ 680,017
Rubber articles, machine for manufacturing, F. H. Turner........ 680,086
Sad irons, detachable handle for, P. C. Greenawalt........ 680,143
Sand line and pump for bailer connection, C. I. Dorn........ 679,889
Sash band fastener, C. H. Ocumpaugh..... 679,904
Saw filing machine, J. E. Hillstrom........ 679,748
Saws, etc., apparatus or engine for reciprocating, J. Evered........ 680,136
Sawing machine, C. Seymour........ 680,078
Sawing machine, cold, H. Untiedt........ 680,089
Scaffold, folding, E. Enos........ 679,959
Scale, computing, T. L. Tincher........ 679,798
Scale, computing spring, L. B. Thomas..... 680,085
Scale dial, computing, L. B. Thomas........ 679,795
Scarf, S. M. Griffiths........ 679,745
Screw driver or kindred tool, B. T. Noble.. 680,065
Screw driver with adjustable side claws, W. L. A. Hecken........ 680,043
Screw, tension, H. E. Keeler........ 679,970
Screws, making, W. A. Warman........ 679,927
Seal, car, A. P. Miller........ 679,979
Sealing parts of machinery, means for, E. Josse........ 679,898
Seam closing strip, F. W. Merrick........ 679,978
Seat, C. Rudolf........ 679,915
Sewing and indenting machine, H. W. Gould 680,142
Sewing buttons to fabrics, machine for, J. T. Hogan........ 679,752
Sewing machine, H. P. Richards........ 679,914
Sewing machine, blind stitch, J. Arbes..... 680,014
Sewing machine lasting attachment, J. Keats........ 680,156
Sewing machine looper operating mechanism, L. Onderdonk........ 679,906
Sewing machine, overseaming, C. J. Appleton........ 680,013
Sewing machine thread controlling device, B. J. Bergman........ 680,192
Shade, window, G. M. Frampton........ 679,736
Sharpening attachment for beef shaving machines, C. B. Hopkins........ 680,045
Sharpening attachment for meat cutters, C. B. Hopkins........ 680,148
Sharpening device, cutter, J. Fellows...... 680,033
Sharpening device for food slicers or cutters, J. Fellows........ 680,137
Shield for wounds, E. C. Shears........ 679,918
Shingles, drying, Gibbard & Anderson...... 680,141
Shutter, rolling, P. H. Wilson........ 680,100
Signaling system, electrical, J. A. Gehrung. 680,036
Silo, R. Stoddard........ 680,008
Skylight, ventilating, J. F. Preuthun........ 679,912
Slicer, food, J. Fellows........ 680,032
Soap cake, T. A. Lynch........ 680,052
Soda water apparatus, H. A. Allwardt...... 680,011
Sound reproducer, L. P. Valiquet........ 679,923
Spark arrester, H. Floyd........ 680,140
Spinning frame, R. J. Chapman........ 680,194
Stalk cutter and rake, combined, R. H. Purnell........ 679,991
Stanchion, cattle, J. G. Fragner........ 679,839
Staple making and driving machine, O. H. P. Cornell........ 679,729
Steam engine, H. F. Colvin....... 679,949, 679,950
Steam trap, Brown & Leuthesser........ 679,826
Stone, manufacture of artificial, P. Cabrie.. 679,828
Stove door and frame therefor, Carter & Hausfeld........ 679,830
Stove grate, C. F. Turner........ 680,185
Stove or furnace, heating, B. B. Christie... 680,123
Stuffing box, Titus & Covert........ 679,922
Sugar or other powdered or pulverized materials, receptacle for, G. B. Crites........ 679,834
Suspender cast-off, A. E. Sawyer........ 679,994
Suspender end, J. Riley........ 679,783
Sweater, O. Friebel........ 680,035
Switchboards, test system for multiple, H. G. Webster........ 679,805
Switch operating mechanism, F. A. Carroll.. 680,020
Talking machines, sound box for, E. R. Johnson........ 679,896
Tea kettle attachment, C. E. Warren....... 679,928
Telegraph relay, J. E. Cordovez........ 680,024
Telegraph system, wireless, H. Shoemaker. 680,002
Telegraphy, wireless, H. Shoemaker........ 680,001
Telephone exchange system, W. M. Davis... 679,731
Telephone exchange system, Sinclair & Aitken........ 679,788
Telephone transmitter arm joint, H. B. Sabin........ 680,077
Telephonic messages, counting, G. Seligmann-Lui........ 679,998
Tentering machine rail, H. A. Tillinghast.. 679,797
Thresher and separator, grain, O. C. Zimmerman........ 680,187
Thresher, pea, M. T. White........ 680,097
Tie holding clasp, Barr & Weil........ 680,109
Time indicator, C. H. Brake........ 680,018
Tinning, material for protecting sheets, etc., in, J. A. Kyle........ 679,972
Toaster, W. Wells........ 680,095
Tobacco pipe charging device, D. H. Allen. 679,872

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Toy, G. Schneider.......... 679,996
Toy pistol, W. H. Wythe.......... 680,126
Track brake, J. G. Smith.......... 680,180
Tramway or railway points, appliance for working, W. J. Stewart.......... 680,007
Trolley wire hanger, A. D. Crossley.......... 679,953
Truck, C. Hoffmann.......... 679,750
Truck for harvesters, tongue, O. S. Ellithorp.......... 679,836
Tufting table, E. Hollatz.......... 680,147
Type writer attachment, Ryther & Cole.......... 679,785
Type writing machine, H. E. Curtis.......... 679,954
Type writing machine, J. Felbel.......... 679,960
Valve, W. H. & R. Thompson.......... 680,209
Valve, automatic hydraulic gravity, G. I. Alden.......... 679,717
Valve, balanced, Johnson & Henderson.......... 679,755
Valve gear mechanism for single acting engines, L. Serpollet.......... 680,000
Valve gearing, W. G. Rice.......... 679,992
Valve mechanism for engines for compressing air or gases, Z. W. Daw.......... 679,965
Valve mechanism, hydraulic, E. E. E. Mears 679,767
Valve, reservoir outlet, E. A. Bromley.......... 679,940
Vehicle door, W. Bahrenburg.......... 679,822
Vehicle gear, F. E. Wilcox.......... 679,810
Vehicle, motor, L. W. Pullen.......... 680,074
Vehicle, spring motor, J. L. McDowell.......... 679,773
Vehicles, etc., seat for, F. M. Light.......... 680,158
Vending machine, F. Bronori.......... 679,879
Vending machine, coin controlled, J. Aarons 679,871
Ventilator, P. Abrahamson.......... 679,932
Waist and skirt supporter, E. M. Adams.......... 680,106
Wardrobe, combination, A. La Mar.......... 680,206
Washboard, C. J. Vohs.......... 679,804
Washstand, W. C. Werum.......... 679,807
Watchcase pendant, E. C. Phillips.......... 680,067
Water heating device, quick, J. Deschamps. 680,027
Weighing and filling machine, H. Inman.......... 679,968
Weighing machine, automatic, J. J. Marshall.......... 680,160
Welding, B. B. Thomas.......... 680,182
Wheel box and axle, D. E. Barton.......... 680,110
Whiffletree, Spillman & Roach.......... 680,006
Whiffletree coupling, T. A. Bakken.......... 680,108
Whip and rein holder, J. E. Williams.......... 680,099
Winding machine, P. J. Westphal.......... 680,210
Winding machines, electrical controlling means for, R. Varley, Jr.......... 679,924
Windmill, K. Gore.......... 680,039
Window cleaner, T. Mart.......... 680,057
Window stop, A. Steiert.......... 680,081
Wire stretching device, W. McCloskey.......... 679,856
Wire tightener, C. F. Stoddard.......... 679,870
Wool, extracting fat from, G. Peltzer.......... 679,777
Wrapping machine, R. Nelson.......... 680,064
Wrench, L. Coes.......... 680,124

DESIGNS.

Badge, G. L. Rockwell.......... 34,888
Bicycle frame, J. L. Knoll.......... 34,903
Bottle, P. E. Malmstrom.......... 34,896
Button, J. F. Boepple.......... 34,893
Car replacer, O. W. Johnson.......... 34,906
Cycles, rear frame for motor, V. H. Bendix.......... 34,902
Engine frame, R. Fuller.......... 34,904
Fence wire, barbed, D. C. Smith.......... 34,900
Gas engine body, H. H. Hennegin.......... 34,905
Grater, C. L. Wagandt.......... 34,898
Knife, J. H. Wray.......... 34,897
Picture frame, Goudie & Henley.......... 34,886
Picture frame, J. A. Kirkham.......... 34,887
Pitcher or mug, H. D. McFaddin.......... 34,895
Range, T. I. Rankin.......... 34,908
Rug, E. H. Bennett.......... 34,913, 34,914, 34,915
Safety pin, J. V. Washburne.......... 34,889 to 34,892
Sewing machine cabinet, Abramson & Person. 34,912
Ship's ventilator, McVeety & Ford.......... 34,907
Snap link, A. Brockelbank.......... 34,899
Stove, S. Sorenson.......... 34,911
Stove, cooking, T. I. Rankin.......... 34,910
Stove, heating, T. I. Rankin.......... 34,909
Thermometer frame, I. Mayer.......... 34,894
Wrenches, slide piece for, A. Dudly.......... 34,901

TRADE MARKS.

Absinthe, E. Cusenier Fils, Aine & Cie.......... 36,872
Atomizer, Mahoning Novelty Co.......... 36,861
Boiler compounds, White Star Chemical Company.......... 36,874
Bookbinders' cloth, Winterbottom Book Cloth Company.......... 36,856
Buildings, certain named exterior and interior wooden finish for, Bristol Door & Lumber Company.......... 36,858
Canned provisions, certain named, Smith Bros Co.......... 36,870
Cantaloups, V. Scalzo Fruit Company.......... 36,869
Carbons for electrical purposes, H. Reisinger 36,875
Crackers, cakes, cookies, biscuits, bread, and pies, Colonial Biscuit Company.......... 36,868
Food products, certain named grain, Kansas City Oat Meal & Cereal Company.......... 36,867
Game, Hamley Brothers.......... 36,854
Glassware, Schott & Gen.......... 36,859
Glassware, pressed, A. A. Heisey & Co.......... 36,860
Guns, W. B. Belknap & Co.......... 36,876
Hair, preparation for the, M. M. Harris.......... 36,863
Malt extracts and peptonized malt foods, A. Lieber.......... 36,866
Medicine for certain named diseases and vaporizers for evaporating same, F. Jacobson 36,862
Paper and envelopes, bond writing, Raynor & Perkins Envelope Company.......... 36,855
Pills for certain named diseases, G. C. Weber 36,864
Pine tree products, certain named, American Consolidated Pine Fibre Company.......... 36,865
Pipe wrenches, J. H. Williams & Co.......... 36,877
Sheetings and drillings, H. B. Claflin Company.......... 36,857
Tobacco, smoking and chewing, Carthage Tobacco Works.......... 36,873
Water, Mountain Valley Springs Company.......... 36,871

LABELS.

"Banquet," for macaroni, L. R. Lorenz.......... 8,578
"Big Success," for cigars, American Lithographic Company.......... 8,574
"Boro-Carbol Salve," for a salve, C. W. Beggs Sons & Co.......... 8,581
"Brown's Magnetic Liniment," for a liniment, G. W. Brown.......... 8,582
"Daggett's Boston Chocolates, for confectionery, F. L. Daggett & Co.......... 8,577
"Direct from the Mill to the Man," for trousers, Rochester Woolen Mfg. Co.......... 8,572
"Dr. Bell's Kidney Pills," for a medicine, C. W. Beggs Sons & Co.......... 8,580
"Maxcy's Violet Cream," for toilet cream, Maxcy Laboratory Company.......... 8,583
"Plantation Tea," for a medicine, D. Thomas. 8,579
"Prophylactic," for toothe brushes, Florence Mfg Co.......... 8,584
"Red Rose Sweet Scotch Snuff," for snuff, Standard Snuff Company.......... 8,575
"Royal Harvest," for cigars, American Lithographic Company.......... 8,573
"Slivovitz," for an alcoholic liquor, W. Moise & Co.......... 8,576

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"Ginty's Bean Tablets," for baked beans and bean tablets, E. C. Ginty.......... 382
"Pay Less and Dress Better," for clothing, Royal Tailors.......... 379, 380, 381
"Royal Fashions Fall 1901, Winter 1902," for clothing, Royal Tailors.......... 378
"The World's Only Dustless," for brushes, Milwaukee Dustless Brush Co.......... 383

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